5100 Series

OPERATING MANUAL

DIGITAL/ANALOG PORTABLE RADIO

5100 Series Portable Radio

VHF/UHF/800 MHz Project 25 Conventional SMARTNET®/SmartZone®

7.2 VDC,
1 and 5 Watts (VHF);
1 and 4 Watts (UHF);
1 and 3 Watts (800 MHz)
Part No. 242-51xx-xxx

EFJohnson®

Part Number 002-5100-1003
June 2003
Supersedes: 002-5100-1002, 10/02

SAFETY TRAINING INFORMATION

WARNING

This radio produces RF electromagnetic energy when transmitting and is designed and classified for "Occupational Use Only". Radio equipment with this classification must be used only during the course of employment by individuals aware of the hazards and the ways to minimize such hazards. This radio is NOT intended for use by the General Population in an uncontrolled environment.

This radio has been tested and complies with FCC RF exposure limits for "Occupational Use Only". In addition, it complies with the following standards and guidelines with regard to RF energy and electromagnetic energy levels and evaluation of such levels for exposure to humans:

- FCC OET Bulletin 65 Edition 97-01 Supplement C, Evaluating Compliance with FCC Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields.

- American National Standards Institute (C95.1-1992), IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz.

- American National Standards Institute (C95.3 -1992), IEEE Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields - RF and Microwave.

CAUTION

To ensure that your exposure to RF electromagnetic energy is within the FCC allowable limits for occupational use, always adhere to the following guidelines:

- DO NOT operate the radio without the proper antenna attached. This may damage the radio and cause FCC RF exposure limits to be exceeded. The proper antenna is the antenna supplied with the radio by the manufacturer or an antenna specifically authorized by the manufacturer for use with this radio.

- DO NOT transmit more than 50% of total radio use time (50% duty cycle). Transmitting for more than 50% of the time can cause FCC RF exposure compliance requirements to be exceeded. This radio is transmitting whenever the indicator on the front panel is red continuously. Pressing the PTT switch on the side usually causes the radio to transmit.

- DO NOT use any accessories not specifically authorized by the EFJohnson Company for use with this radio such as batteries, speaker-microphones, belt clips, and antennas. The use of unauthorized accessories can cause FCC RF exposure compliance requirements to be exceeded.

- ALWAYS keep the antenna and radio at least 2.54 cm (1.0 inch) away from your body when transmitting to ensure FCC RF exposure compliance requirements are not exceeded. The best transmission quality results when the antenna is at least 5 cm (2 inches) away from your mouth and angled slightly to one side.

- This unit has not been tested for FCC RF exposure compliance in applications where the unit is transmitting while body worn on the belt clip. This product is not intended for use in applications where transmissions are required while the unit is body worn with the use of the belt clip.

NOTE: The preceding information is provided to make you aware of RF exposure and what to do to ensure that this radio is operated within FCC RF exposure limits.

Electromagnetic Interference/Usage Compatibility

This device complies with Part 15 of the FCC rules. Operation is subject to the condition that this device does not cause harmful interference. In addition, changes or modification to this equipment not expressly approved by the EFJohnson Company could void the user's authority to operate this equipment (FCC Rules, 47CFR Part 15.19).

DO NOT operate it in areas that are sensitive to RF energy such as aircraft, hospitals, blasting sites, and fuel storage sites. Areas with potentially flammable atmospheres are usually, but not always, clearly posted. These may include gas stations, fuel and chemical storage and transfer stations, below deck on boats, and areas where the air contains flammable chemicals or particles such as grain dust or metal powders.

Dispose of the nickel metal-hydride (NiMH) or nickel-cadmium (NiCd) battery used by this radio in accordance with local regulations. DO NOT dispose of it in fire because it can explode. Also, do not short the terminals because it may become very hot.

51xx SERIES PORTABLE OPERATING MANUAL

VHF/UHF/800 MHz
PROJECT 25 (DIGITAL) AND ANALOG
SMARTNET®/SmartZone®

The EFJohnson Company, which was founded in 1923, provides wireless communication systems solutions for public safety, government, and commercial customers. The company designs, manufactures, and markets conventional and trunked radio systems, mobile and portable subscriber radios, repeaters, and Project 25 digital radio products. EFJohnson is a wholly owned subsidiary of EFJ, Inc.

LAND MOBILE PRODUCT WARRANTY - The manufacturer's warranty statement for this product is available from your product supplier or from EFJohnson Company, 299 Johnson Avenue, Box 1249, Waseca, MN 56093-0514. Phone (507) 835-6222.

Information in this manual is subject to change without notice.

5100 Flash Version 1.9.0/PCConfigure Version 1.20

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SECTION 1 FEATURES

Figure 1-1 Front Panel Controls

NOTE: The availability of many of the following features is controlled by factory coding of your transceiver, installed options, and field programming. Refer to Section 9 for more information.

1.1 GENERAL FEATURES

- The following operating modes are programmable:
  - – Conventional analog
  - – Conventional Project 25 (digital)
  - – Trunked Project 25 (digital)
  - – SMARTNET™/SmartZone® trunked (analog or digital)
- Up to 16 zones with 16 channels each (256 channels total) are standard. Up to 32 zones and 512 channels total are optional.
- Large graphic display with backlight
- Up to 9 (limited keypad) or 21 (DTMF keypad) programmable option switches
- Menu mode
- Standard and radio-wide scan modes
- Time-out timer
- User selectable high and low power output
- Keypad lock to prevent accidental key presses
- Operates on both wide and narrow band channels
- Power-up password to prevent unauthorized use
- Adjustable tone volume (with Flash code 1.9.0 or later only)
- Soft power down (with Flash code 1.9.0 or later only)

1.2 CONVENTIONAL FEATURES

- Up to 512 channels or talk groups programmable
- Repeater talk-around
- Carrier or Call Guard® controlled squelch on analog channels, NAC and talk group IDs on P25 channels.

- Normal/selective squelch selectable by option switch or menu
- Monitor mode selectable by option switch or menu
- Penalty and conversation timers
- Dual priority channel sampling when scanning (analog channels only)
- Busy channel lockout (transmit disable on busy)
- Unit calls on P25 channels
- Cloning capability
- Emergency alarms and calls to alert a dispatcher of an emergency condition (analog emergency available only with Flash code 1.8.0 or later).
- Single tone encoder controllable by user on analog channels
- ANI (Automatic Number Identification) on analog channels
- Call Alert™ on P25 channels (send and receive pages) with Flash code 1.8.0 or later.
- Predefined messages (up to 16) can be sent to a dispatcher (P25 mode with Flash code 1.8.0 or later only)
- Predefined status conditions (up to 8) can be sent to a dispatcher (P25 mode with Flash code 1.8.0 or later only)
- SecureNet™ DES voice encryption available on analog channels, DES-OFB and AES on P25 channels (AES encryption available only with Flash code 1.8.0 or later).
- OTAR (Over-The-Air-Rekeying) compatible (P25 channels with Flash code 1.5.0 or later).
- Keypad programming with password access (Federal Government users only)

1.3 SMARTNET/SMARTZONE FEATURES

- Up to 512 talk groups programmable (channels select talk groups)
- Group, Enhanced Private Conversation™, standard Private Conversation, and Telephone* Calls
- Emergency alarms to alert a dispatcher of emergency conditions
- Emergency calls for high priority system access
- Failsoft operation on a predefined conventional channel if trunked system fails
- Priority group calls detected while listening to other group calls when scanning
- Call Alert™ (send and receive pages)
- Predefined messages (up to 16) can be sent to a dispatcher
- Predefined status conditions (up to 8) can be sent to a dispatcher
- Dynamic regrouping (dispatcher can automatically gather users on a channel to receive a message)
- Roaming (SmartZone only)
- SecureNet™ DES secure communication available on analog channels (SmartZone requires Flash code 1.7.0 or later). DES-OFB and AES on digital channels (AES encryption available only with Flash code 1.8.0 or later).

1.4 PROJECT 25 TRUNKED FEATURES

- Up to 512 talk groups programmable (channels select talk groups)
- Group and Unit Calls
- Emergency alarms to alert a dispatcher of emergency conditions
- Emergency calls for high priority system access
- Failsoft operation on a predefined conventional channel if trunked system fails
- Priority group calls detected while listening to other group calls when scanning
- Call Alert™ (send and receive pages)
- Predefined status conditions (up to 8) can be sent to a dispatcher
- Dynamic regrouping (dispatcher can automatically gather users on a channel to receive a message)
- Roaming
- SecureNet™ DES-OFB and AES secure communication available (AES encryption available only with Flash code 1.8.0 or later)

***** *Telephone calling is currently not available.*

SECTION 2 CONTROLS AND DISPLAY

2.1 FRONT PANEL CONTROLS

NOTE: The location of these controls is shown in Figure 1-1.

Microphone - The microphone is located behind the small opening shown in Figure 1-1. For best results, hold the transceiver 2-3 inches from you mouth and speak at a normal conversational level. Do not shout since it distorts your voice and does not increase range.

Display - This is a graphical LCD (Liquid Crystal Display). The display backlight can be programmed to turn on when any key is pressed or when the Backlight option switch is pressed or menu parameter selected (see Section 3.5).

Up/Down Switch - Selects zones when multiple zones are programmed (see Section 3.3). Pressing the upper part of the switch selects the next higher number and pressing the lower part selects the next lower number. This control also provides up/down select in the menu mode and in other modes when up/down select is required.

F1 - In menu mode (see Section 4.2), functions as a step back and exit switch. If menu mode is not used, it is a programmable option switch.

F2 - Selects the menu mode when it is enabled by programming. Also functions as an Enter or Select switch in the menu and other modes. If menu mode is not used, it is a programmable option switch.

F3, F4 - Programmable option switches.

DTMF Keypad - The full keypad DTMF models include the 12 keys required to dial telephone and unit ID numbers.

Speaker - The transceiver speaker is located near the bottom of the front panel. When a speaker/microphone is used, it is automatically detected when the Opt Sel 1 line of the accessory connector is pulled low. The logic then automatically disables the internal speaker.

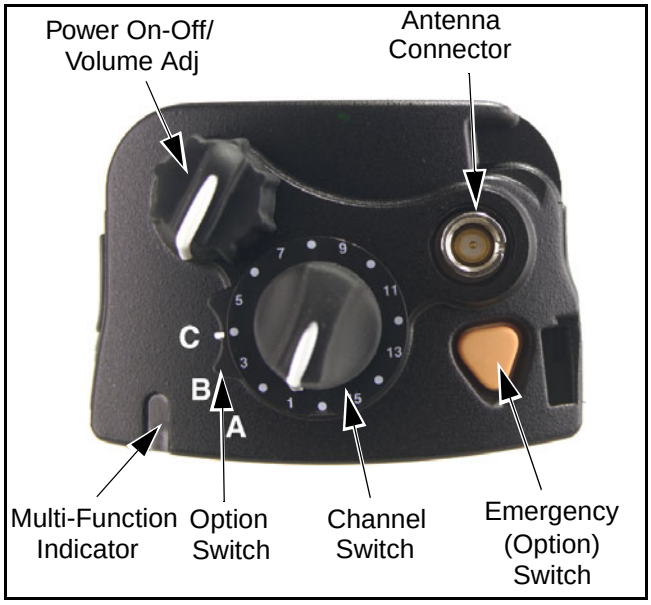

Figure 2-1 Top Panel Controls

2.2 TOP PANEL CONTROLS

Multi-Function Indicator - Indicates the following conditions:

Steady Red - Transmitter keyed.
Flashing Red - Low battery in receive mode.
Steady Green - Carrier detected in receive mode.

NOTE: This indicator is disabled if the Surveillance mode is programmed (see Section 4.7).

On-Off/Volume - Turning the knob clockwise turns power on and sets the volume level. Turning it counterclockwise to the detent turns power off. The minimum volume level can be set by programming.

Channel Switch - This 16-position switch selects up to 16 channels in the current zone. Additional zones can be programmed to allow up to 512 channels to be selected by this switch.

Rotary Option Switch - This is a three-position switch that can be programmed to control various options. The “A” position is “off” and the “B” and “C” positions are “on” (see Section 4.1). When this switch

is programmed to select zones, “A” selects Zone 1, “B” Zone 2, and “C” Zone 3 if applicable (available only with Flash code 1.7.0 or later).

Antenna Connector - Connection point for the antenna. Make sure the antenna is tight before using the radio.

Emergency Switch - This switch or some other option switch can be programmed as an Emergency switch to alert a dispatcher of an emergency condition. Refer to Sections 5.10 and 6.10 for more information. This switch can also be programmed for other functions.

2.3 SIDE CONTROLS

Figure 2-2 Side Controls and Jacks

PTT (Push-To-Talk) Switch - This switch is pressed to turn the transmitter on to transmit a message. It is then released to listen. Transmitting is indicated when the top panel indicator is constant red.

Option Switches 1, 2, and 3 - Each of these switches can be programmed to control a specific function (see Section 4.1).

Battery - To remove the battery, press the release button on the bottom and pivot the bottom of the battery outward.

Accessory Connector - Connection point for optional accessories such as a speaker/microphone or earphone. It is also used for connecting the computer when programming the transceiver.

2.4 DISPLAY

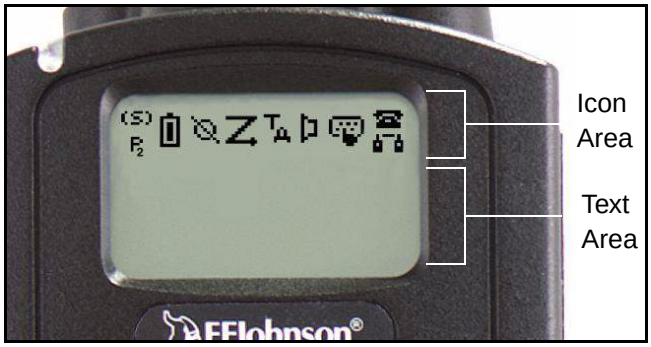

Figure 2-3 Graphical Display

The front panel display is shown above. Icons are typically shown in the upper part of the display and text messages in the lower part. The default icons are as follows:

(S) - When the scan or the scan list edit mode is enabled, indicates that the displayed channel is in the scan list and scanned normally (see Section 4.8).

P - When the scan or the scan list edit mode is enabled, indicates that the displayed channel is a priority channel. If dual priority is used, P2 indicates that it is a second priority channel.

- Low battery indication (see Section 3.4).

- Voice encryption is enabled (see Section 8.1).

- Standard or radio wide scanning is enabled (see Section 4.8).

- Repeater talk-around is enabled (see Section 5.8).

- Monitor mode is enabled by the Monitor option switch or menu parameter (see Section 5.3).

- Keypad programming or another mode is enabled which allows the user to edit radio parameters.

- A SMARTNET/SmartZone interconnect* (telephone) call is in progress (see Section 6.6).

- A Project 25 or SMARTNET/SmartZone private (unit-to-unit) call is in progress.

***** *Telephone calling is currently not available.*

SECTION 3 GENERAL OPERATION

3.1 TURNING POWER ON AND SETTING VOLUME

3.1.1 POWER UP

Power is turned on and off by the top panel On-Off/Volume switch. When power is initially turned on, the following events occur:

- The software version number is displayed.
- A self test is performed.
- The currently selected zone is displayed.
- If a conventional P25 channel is selected, the Individual ID of the radio is displayed.
- If a SMARTNET/SmartZone or P25 Trunked channel is selected, the Unit ID of the radio is displayed.
- A tone sounds (if tones are enabled)
- The selected channel alias is displayed continuously when power-up is complete.

Programming determines if the transceiver powers up on the last selected zone or the pre-programmed home zone. Refer to Section 3.3 for information on the channel that is selected. The minimum volume level may be set by programming. This can prevent missed messages resulting from inadvertently turning the volume to an inaudible level.

3.1.2 STANDARD AND SOFT POWER DOWN

To turn power off, rotate the On-Off/Volume control counterclockwise until a click occurs. Power may remain on for an instant after turn-off occurs.

A soft power down feature* can be programmed to prevent radio power from being turned off by accidentally turning the on-off/volume control. Any side button can be programmed for this function (in addition to the normal function). Then for power to turn off, this button must be pressed during or after power is turned off in the normal manner using the knob. Simply turning the on-off/volume control to off with this feature programmed has no affect.

3.1.3 SETTING VOLUME LEVEL

The relative volume level can be determined by the position of the index on the volume knob or a reference tone as follows:

- If a key press tone is enabled, a short tone sounds when a key is pressed.

- If a conventional channel is selected and the Monitor option switch or menu parameter is programmed, pressing that switch unsquelches the receiver and either voice or background noise is heard (see Section 5.3). If a SMARTNET/SmartZone or P25 Trunked channel is selected, the receiver cannot be manually unsquelched.

3.2 POWER-UP PASSWORD

The power-up password feature prevents unauthorized use of the transceiver by locking the keypad on power up until the proper password is entered. This feature is enabled or disabled by programming.

When it is enabled, “ENTER PSWD” is briefly displayed when power is turned on. The eight-digit numeric password must be then be entered as follows. In addition, since the logic resets each time programming data is read or written, it must be entered after performing those functions. If an incorrect password is entered, “INCORRECT” is displayed and it must be re-entered.

DTMF Keypad Models - Enter the password using the 1-8 keys and then press the Enter (F2) key when finished. If a mistake is made, the last digit can be erased by pressing the F1 (Clear) key.

Limited Keypad Models - Select the proper number for each position by pressing the Up/Down switch. When the proper number for a position is displayed, select it and move on to the next position by pressing the F2 (Enter) key.

This password can be changed only by the programmer (see Section 4 of the 5100 Service

** This feature requires 51xx operating (Flash) software 1.9.0 or later and PCConfigure 1.20 or later.*

Manual). It cannot be changed by the user. If it is lost, all programming must be erased to make the transceiver operational again. This is done using the "EEPROM Erase" function of the PCTune program (see Section 6.3.3 of the 5100 Service Manual). This password is displayed by the programmer when data is read. However, data cannot be read (or written) when the transceiver is locked, so the lost password cannot be determined using the programmer.

3.3 ZONE AND CHANNEL SELECT

The selected zone and channel are selected and displayed as follows. For more information on zones and channels, refer to Section 3.8.5.

Zone Select

The front panel Up/Down switch changes and displays the current zone. When not in special modes such as the menu mode, pressing either the top or bottom part of this switch once displays the alias of the current zone. Then quickly pressing it again changes the selected zone up or down. The rotary A/B/C switch on the top panel can also be programmed for zone select (with Flash code 1.7.0 or later). The "A" position then selects Zone 1, "B" Zone 2, and "C" Zone 3 (if applicable).

After the highest programmed zone is displayed, wrap-around to the lowest programmed zone occurs and vice versa. The selected zone is also displayed briefly on power up. If the selected zone alias needs to be displayed continuously, it must be programmed as part of the channel alias.

Channel Select

Channels are selected by the rotary 16-position switch on the top panel. The alias (identification) for the selected channel/group is displayed continuously during normal operation.

When an unprogrammed channel is selected, "UNPROGRAMD" is displayed and a tone sounds (if tones are enabled). When conventional channels are selected and the Display Information option key or menu parameter is programmed, either the channel frequency or alias can be displayed (see Section 5.9).

The channel selector knob can also be disabled by programming. Channels must then be directly selected as described next (if applicable). This knob may be disabled when direct selection is used to prevent confusion because it then may not correctly indicate the selected channel.

Direct Zone/Channel Selection*

The direct Channel Select feature is available if the Channel Select option switch or menu parameter is programmed. This feature allows channels to be directly selected using the DTMF keypad numeric keys (DTMF models only) or Up/Down switch (all models).

For direct selection purposes, channels are numbered sequentially starting with the lowest zone. Each zone can be programmed with up to 16 channels, so Zone 1 channels are numbered 1-16, Zone 2 channels 17-32, and so on as shown below. For example, Zone 1/Channel 16 is selected by Channel 16, and Zone 2/Channel 16 is selected by Channel 32.

Zone	Ch.	Seq. Ch. No.
1	1 ↓ 16	1 ↓ 16
2	1 ↓ 16	17 ↓ 32
3	1 ↓	33 ↓

Proceed as follows to select channels using this mode:

1. Enable the direct Channel Select mode by pressing the Channel Select option switch or selecting the "Chan Selct" menu parameter. The alias and sequential number of the current channel are alternately displayed.

2. Select the desired channel using the Up/Down keys or directly enter it using the 0-9 keys (if available).

** This feature requires 51xx operating (Flash) software 1.5.0 or later and PCConfigure 1.17 or later.*

If using the 0-9 keys, the radio attempts to display the entered number after the 3rd digit is entered or approximately 2 seconds after the last key is pressed.

3. To exit the this mode and select the entered channel, press the Channel Select switch again or the F2 key. To exit without changing the channel, press the F1 key. This mode is also exited automatically without changing the channel after approximately 1 minute of no activity.

NOTE: The Channel Select function should probably not be assigned to a number key because pressing that key to select a channel then exits the select mode.

Other features of this mode are as follows:

- When using the Up/Down keys, wrap-around to the lowest zone/channel occurs after the last channel in the highest programmed zone is displayed and vice versa. For example, if Zone 1/Channel 5 is the highest programmed channel, wraparound occurs after Zone 1/Channel 16 is displayed.

- When an unprogrammed channel is displayed, the sequential channel number and "Unprogramd" are alternately displayed.

- If an invalid channel number is entered using the 0-9 keys, or the F2 or Channel Select open switch is pressed with "Unprogrammed" displayed, an error tones sounds, "Invalid" is briefly displayed, and the displayed channel does not change.

- The rotary Channel Select switch may not correctly indicate the selected channel after direct channel selection is used. However, if this switch is enabled by programming and rotated, it selects the channel it is indicating. For example, if the switch index is pointing to channel 3 and channel 15 of the current zone is being displayed, rotating it to channel 4 selects channel 4 of the current zone.

- If the rotary Channel Select switch is enabled, the radio always powers up on the channel it is selecting.

  If it is disabled, the radio can be programmed to power-up on the last selected or home channel number of the last selected or home zone*. With the "Last Zone"/"Home Channel" configuration, the programmed home channel number of the last active zone is selected. If it is not programmed, "Unprogrammd" is displayed. With earlier models, the last selected channel is displayed when powering up on the last selected zone, and channel 1 is displayed when powering up on the home zone.

3.4 LOW BATTERY INDICATION

NOTE: If the transceiver contains encryption (hardware) keys, be sure to reattach a battery within approximately one minute to prevent the loss of these keys.

A low-battery condition is indicated by the  icon in the display. The battery should be recharged or replaced as soon after this indication appears. Once this indication appears, it stays on until power is cycled.

The following additional low battery indications and conditions may be enabled by programming:

- A chirp sounds once a minute in the standby and transmit modes.
- A chirp sounds each time the PTT switch is pressed.
- The top panel LED indicator flashes red every 30 seconds in the receive mode.
- Low power is selected when transmitting.

As indicated in the preceding "Note", the transceiver must be connected to a constant power source to preserve the encryption (hardware) keys in memory. To allow the battery to be changed without losing these keys, storage capacitors maintain the supply voltage to memory for approximately 1 minute without a battery attached. Therefore, when changing the battery of a transceiver that has these keys stored, be sure to reattach a battery within that time. Refer to Section 8.1.5 for more information on encryption keys.

There is a battery saver feature that can be enabled by programming. This feature functions on trunked channels and Flash code 1.7.0 or later only, and it causes low transmit power to be selected when the receive signal strength (RSSI) indicates that the site is nearby.

** This feature requires 51xx operating (Flash) software 1.9.0 or later and PCConfigure 1.20 or later.*

3.5 BACKLIGHT

The backlight for the display and option keys can be programmed to automatically turn on when any key is pressed. It then automatically turns off after a programmed delay of 0-7.5 seconds so that battery drain is minimized. If the Backlight option switch or menu parameter is programmed, the user can manually turn the backlight on and off (it then stays on). If the Surveillance mode is programmed, the backlight is disabled (see Section 4.7).

3.6 KEYPAD LOCK

The Keypad Lock feature temporarily disables the front panel keys to prevent accidental key presses. This feature is available if the Keypad Lock option switch is programmed.

To lock the keypad, simply press the Keypad Lock option switch. Then to unlock the keypad again, press and hold this switch until a tone sounds or for approximately 1 second.

With DTMF models, the DTMF keys can be totally disabled by programming. In addition, they can be selectively enabled or disabled on conventional analog channels.

3.7 SETTING SQUELCH

This transceiver does not have a squelch control. The squelch level is preset during alignment. If the keypad programming feature is available (see Section 5.17), the squelch level can be changed by the user on each conventional analog channel.

3.8 TRANSCEIVER OPERATING MODES

3.8.1 GENERAL

Each selectable channel can be programmed for the conventional (analog or Project 25 digital), SMARTNET/SmartZone, or Project 25 digital trunked operating mode. For example, Zone 1/Channel 1 could be a conventional channel, Zone 1/Channel 2 a SMARTNET channel, and so on. More information on these modes follows.

3.8.2 CONVENTIONAL MODE

This is a non-trunked operating mode which accesses independent radio channels. There is no automatic access to several channels. Selecting a conventional channel selects a transmit and receive frequency and other channel parameters such as squelch control coding.

Conventional channels can be either standard (analog) or Project 25 (digital). With digital operation, the DSP (Digital Signal Processor) converts the audio signal to digital data which is sent over the air as complex tones. Another difference is that analog channels use Call Guard (CTCSS/DCS) squelch control and Project 25 channels use a NAC (Network Access Code) and talk group ID codes.

With Project 25 operation, a NAC is transmitted and it must match the NAC programmed in the base equipment and the mobile(s) being called for communication to occur. In addition, to receive standard group calls, the receiving mobile must be programmed to detect the transmitted talk group ID code.

With conventional operation, a busy channel condition is detected automatically if the busy channel lockout (transmit disable on busy) feature is programmed. Otherwise, it must be detected manually. An out-of-range condition is not indicated by special tones or messages as with SMARTNET operation because there is no initial data exchange with the repeater that allows this condition to be detected. Operating features unique to conventional channels are described in Section 5.

3.8.3 SMARTNET/SMARTZONE MODE

This is a trunked operating mode in which automatic access is provided to several RF channels. ID codes are used to select what mobiles are being called and what calls are received. Monitoring is performed automatically and special messages and tones indicate busy and out-of-range conditions.

SMARTNET and SmartZone operation and programming is very similar. Basically, SMARTNET operation is limited to a single repeater site and SmartZone operation allows automatic roaming between sites. Enhanced SMARTNET/SmartZone features

include roaming (SmartZone only), telephone*, private, and emergency calls, Call Alert™, and messaging. Either analog or digital signaling may be used.

When a SMARTNET or SmartZone channel is selected or the radio is powered up on one of those channels, it searches for a control channel. Once a control channel is found, the alias (name) of the selected channel is displayed and the radio attempts to register on the radio system. If a control channel could not be found (because of an out of range condition or the system ID is not correct, for example), “NO SYS” (early units) or “Out Rnge” (later units) is displayed and the radio continues to search for a control channel.

The control channel transmits and receives system information to and from all radios registered on the system. Therefore, once a control channel is found, it is continuously monitored for incoming call information and is used to make call requests. The radio automatically changes to a traffic channel to place and receive calls and then returns to the control channel when the call is complete. Operating features unique to SMARTNET/SmartZone channels are described in Section 6.

3.8.4 P25 TRUNKED MODE

The P25 Trunked operating features are very similar to the SmartZone type just described. Since SmartZone features are also similar to SMARTNET features, all three modes are described in the Section 6. Some differences between the P25 Trunking and SmartZone modes are as follows:

- Digital signaling is always used with P25 calls. Either analog or digital signaling may be used for SmartZone calls.
- Calls made to a specific mobile in the P25 mode are called Unit Calls. In the SMARTNET/SmartZone mode they are called Private Calls.
- Messaging is not available with P25 calls.
- Telephone calls are currently not available in this mode.
- The P25 control channel data rate is 9600 baud and the digital voice data rate is also 9600 baud. With SmartZone operation, the control channel data rate is 3600 baud (both digital and analog calls) and the narrowband digital voice data rate is 9600 baud.
- The P25 mode uses a system ID, Wide Area Communications Network (WACN) ID, and RF Subsystem ID (RFSS). The SmartZone mode does not use the WACN and RFSS IDs.
- P25 Unit IDs can be 1-16,777,215 (000001-FFFFFF hex) and SmartZone Unit IDs can be 1-65,535 (0001-FFFF hex).

3.8.5 SYSTEMS, CHANNELS, AND ZONES

A zone and channel are selected to place and receive calls. The following describes the relationship between systems, channels, and zones.

Systems

A system is a collection of channels or talk groups belonging to the same repeater site. It defines all the parameters and protocol information required to access a site. Up to 16 systems of any type can be programmed.

The maximum number of channels assignable to a system is limited to 256 with standard models or to approximately 512 with the 512-channel option. Channels may also be limited by available memory space as described in the following information.

Channels

A channel selects a radio (RF) channel or talk group as follows:

Conventional Analog Mode - A channel selects a specific radio channel, Call Guard (CTCSS/DCS) squelch coding, and other parameters unique to that channel.

Conventional Project 25 Mode - A channel selects a specific radio channel, NAC squelch coding, talk group ID, and other parameters unique to that channel.

***** *Telephone calling is currently not available.*

Mode - A channel selects a specific talk group ID and other parameters unique to that talk group.

SMARTNET/SmartZone and Trunked Project 25 Modes - A channel selects a specific talk group, announcement group, emergency group, and other parameters unique to that talk group.

A maximum of up to 512 channels can be programmed with the preceding modes (with the 512-channel option). These channels can belong to a single system or multiple systems. The maximum number is also limited by the available memory. For example, since more memory is required to program a SMARTNET system than a conventional system, the total number of channels decreases as the number of SMARTNET channels increases. The programming software displays a bar graph which shows the amount of available memory space that is used by the current data.

Zones

A zone is a collection of up to 16 channels of any type. For example, a zone could include 12 conventional channels and 4 SMARTNET channels. One use of zones may be to program the channels used for operation in a different geographical areas. The maximum number of zones is limited to 16 with standard models or to 32 with the 512-channel option.

SECTION 4 RADIO-WIDE FEATURES

4.1 OPTION SWITCHES

Almost all the buttons on this transceiver are programmable. The programmable switches are as follows:

- On the side panel, the three switches above the PTT switch (see Figure 2-2 on page 10).
- On the top panel, the rotary three-position switch and the orange switch (see Figure 2-1 on page 9).
- On the front panel, F1 and F2 unless the menu mode is used (see next section), and F3 and F4.
- With DTMF keypad models, all 12 DTMF keys.

The functions that can be controlled by option switches are shown in Table 4-1. Each option switch can be programmed to control a different function in each of the three operating modes. For example, F3 can control one function when a conventional channel is selected, another when a SMARTNET/SmartZone channel is selected, and still another when a Project 25 trunked channel is selected.

4.2 MENU MODE

Most functions that can be controlled by an option switch can also be controlled by the menu mode. The functions that can be controlled by the menu mode are shown in Table 4-1. Functions can be controlled by both an option switch and a menu parameter if desired.

Menu Mode Buttons

When the menu mode is used, the F1 and F2 switches become dedicated menu mode control switches. The F1 switch is Back/Clear, and the F2 switch is Menu Select/Enter. If the menu mode is disabled, these switches can be programmed for other functions.

Only the enabled menu items which apply to the selected channel type are displayed. For example, if a conventional channel is selected, only the enabled functions for conventional channels are displayed.

When in the menu mode, messages continue to be received on the selected channel. However, the display does not indicate who is calling. Pressing the PTT switch exits the menu mode and keys the transmitter.

The menu mode operates as follows:

1. To select the menu mode, press the F2 key. Up to three menu parameters are then displayed as shown in the preceding photo.

2. To scroll up or down through the menu parameter list, press the Up/Down switch. The selected parameter is indicated by a dark bar.

3. To display the available modes for a highlighted parameter, press the F2 switch. The currently selected mode is indicated by an asterisk.

4. Press the Up/Down switch to highlight the desired mode. Then press the F2 key to select that mode.

5. To step back to the previous level or exit the menu mode, press the F1 (Clear) key.

4.3 TIME-OUT TIMER

The time-out timer disables the transmitter if it is keyed continuously for longer than the programmed time. It can be programmed for 15 seconds to 3 minutes, 45 seconds or it can be disabled.

If the transmitter is keyed for longer than the programmed time, the transmitter is disabled, a continuous tone sounds, and "TX TIMEOUT" is displayed. Five seconds before time-out occurs, a warning beep sounds to indicate that time-out is approaching. The timer and tone are reset by releasing the PTT switch.

A different time can be programmed for each system, and the timer can be enabled or disabled on each conventional channel. With conventional channels, a penalty time may also be programmed that prevents transmissions for a certain time after the transmitter is disabled (see Section 5.6).

One use of this feature is to prevent a channel from being kept busy for an extended period by an accidentally keyed transmitter. It can also prevent possible transmitter damage caused by transmitting for an excessively long period.

4.4 HOME ZONE/CHANNEL SELECT

If the Home Zone option switch or menu parameter is programmed, it selects the preprogrammed home zone. The selected channel is displayed if the channel switch is enabled, and the preprogrammed home channel is selected if it is disabled. The transceiver is also programmed so that either the home or last selected zone is selected when power is turned on. Refer to Section 3.3 for more information.

4.5 POWER OUTPUT SELECT

Each conventional channel and SMARTNET/SmartZone and P25 Trunked system can be programmed for high, low, or switchable power. If the High/Low Power option switch or menu parameter is programmed and selectable power is programmed on the current channel or system, high and low transmitter power can be selected. All models support high and low power.

The new level is flashed in the display as either "HI POWER" or "LOW POWER". If selectable power is not permitted on the current channel, "FIXED LOW" or "FIXED HIGH" is flashed and no change occurs. The selected power level for a channel is permanent until it is manually changed again. The low power mode may be automatically selected during a low battery condition (see Section 3.4).

4.6 ALERT TONE SELECT

The various alert tones that sound are described in Section 7.1. These tones can be turned on and off if the Alert Tone option switch or Tones menu parameter is programmed. When all tones are off, "TONE OFF" is momentarily displayed, and when all tones are on, "TONE ON" is momentarily displayed. If this switch or menu parameter is not programmed, tones are fixed in the on or off mode by programming. If the Surveillance mode is programmed (see following), tones are totally disabled.

The Alert Tone volume* can be adjusted relative to the volume control setting. This is done by programming and also by the user if the Tone Volume Adjust option button or menu parameter is programmed. Relative levels of –170 to +170 can be set with "0" the default setting. A minus value

** This feature requires 51xx operating (Flash) software 1.9.0 or later and PCConfigure 1.20 or later.*

Table 4-1 Programmable Option Switch and Menu Mode Functions

Function	Menu Display	Available in Mode:				See Descript. in Section:
		Conv.	P25 Trk	SMARTNET	SmartZone	
Alert tones On-Off	Tones	X	X	X	X	4.6
Backlight On-Off	Backlight	X	X	X	X	3.5
Call Alert Select	Call Alert	X	X	X	X	5.16.6, 6.7
Call Response Select	Call Rsp		X	X	X	6.5
Change Keyset	Chg Keyset	X				8.2.10
Channel Select	Chan Selct	X	X	X	X	3.3
Clear/Secure Select	Security	X	X	X	X	8.1.6
Clone Select (menu only)	Clone	X				5.14
Configure (menu only)	Config	X	X	X	X	Not curr. used
Digital Talk Group Select	Select TG	X				5.16
Display Information Select	Display	X				5.9
Emergency Select	Emergency	X	X	X	X	5.10, 6.10
Erase Keys (menu only)	Erase Keys	X	X	X	X	8.2.10
High/Low Power Select	Tx Power	X	X	X	X	4.5
Home Zone Select	Home Zone	X	X	X	X	4.4
Key Select	Key Select	X				8.2.10
Keypad Lock Select	(Opt sw only)	X	X	X	X	3.6
Keypad Programming Select	Keypad Prg	X				5.17
Messaging	Message	X		X	X	5.16.7, 6.8
Monitor Mode Select	Monitor	X				5.3
Normal/Selective Select	Squelch	X				5.5
OTAR Rekey Request	OTAR Rekey	X				8.2.10
Phone Call Select	Phone			X	X	6.6
Priority Channel Select	Priority	X				5.11.3
Private Call Select	Priv Call			X	X	6.5
Radio Wide Scan Select	RW Scan	X	X	X	X	4.8
Repeater Talk-Around Select	Talk Arnd	X				5.8
Scan Mode Select	Scan	X	X	X	X	4.8
Scan List Edit Select	Scan Edit	X	X	X	X	4.8
Scan List Select	Scan Selct	X	X	X	X	4.8
Squelch Select List	Sqlch Code	X				5.5
Single Tone Encoder	Tone Encdr	X				5.15
Site Lock Select	Site Lock		X		X	6.14
Site Search Select	Site Srch		X		X	6.14
Status Select	Status	X	X	X	X	5.16.8, 6.9
Surveillance Mode Select	Surv Mode	X	X	X	X	4.7
Tone Volume Edit	Tone Vol	X	X	X	X	4.6
Unit Call Select	Unit Call	X	X			5.16
Unprogrammed (not used)	-	X	X	X	X	-

decreases the tone volume and a plus value increases it. The user adjusted level permanently overrides the programmed level if applicable.

4.7 SURVEILLANCE MODE

If the Surveillance mode* is programmed, the backlight, all alert tones, and front panel LED indicator are totally disabled in all operating modes. This feature can be turned on and off** by the user if the Surveillance Mode option button or menu parameter are programmed. The user selected mode permanently overrides the programmed mode if applicable.

4.8 SCANNING

4.8.1 INTRODUCTION

Scanning monitors the channels in the scan list for messages that the transceiver is programmed to receive. When a message is detected, scanning stops and the message is received. Shortly after the message is complete, scanning resumes (unless it has been disabled).

There are two basic scan modes available: Standard and Radio Wide. The operation of the standard type is unique to the type of channel selected, and the operation of Radio Wide type is the same regardless of the type of channel selected. Only one type can be enabled at a time. For example, if standard scanning is enabled and radio wide scanning is selected, standard scanning is automatically disabled and vice versa. More information on these types of scanning follows.

4.8.2 STANDARD SCANNING

Standard scanning monitors only channels that are the same type as that currently selected. For example, if a conventional channel is selected, only conventional channels are scanned and likewise for SMARTNET/SmartZone and Project 25 Trunked channels. More information on how standard scanning operates in these modes is located in the following sections:

Conventional Mode - Section 5.11
Other Modes - Section 6.12

Standard scanning is turned on and off by the Scan option switch or menu parameter as follows. If this switch or menu parameter is not programmed, standard scanning is not available.

- Enable scanning using the Scan option switch or menu parameter. Scanning is enabled when the Z icon is displayed.
- To turn scanning off, press the Scan option switch again or select “Off” in the scan menu. Scanning is disabled when the Z icon is no longer displayed.
- If the zone or channel is changed while scanning is selected, scanning continues on the same or a different scan list (see “Standard Mode Scan Lists” on page 20).

NOTE: Each SMARTNET/SmartZone and P25 trunked channel can be programmed so that scanning is automatically enabled when the channel is selected.

4.8.3 RADIO WIDE SCANNING

NOTE: Use radio wide scanning only if two types of channels need to be scanned at the same time such as conventional and SMARTNET/SmartZone. Otherwise, use the more efficient standard scanning because there is less chance of missed calls.

Radio wide scanning monitors the channels in the preprogrammed radio-wide scan list. This scan list can include up to 16 channels of any type and assigned to any zone (see “Radio Wide Scan List” on page 20). Radio wide scanning is turned on and off by the Radio Wide Scan option switch or menu parameter as follows. If this switch or menu parameter is not programmed, radio wide scanning is not available.

- Enable Radio Wide Scanning using the Radio Wide Scan option switch or menu parameter. As with standard scanning, radio wide scanning is indicated when the Z icon is displayed.
- To turn radio wide scanning off, press the Radio Wide Scan option switch again or select “Off” in the menu. Scanning is disabled when the Z icon is no longer displayed.

** This feature requires 51xx operating (Flash) software 1.5.0 or later and PCConfigure 1.17 or later.*

*** This feature requires 51xx operating (Flash) software 1.9.0 or later and PCConfigure 1.20 or later.*

- If the zone or channel is changed while radio wide scanning, scanning continues normally.

4.8.4 SCAN HOLD TIME

When a message is received or transmitted while scanning, there is a delay before scanning resumes. The delay after receiving a call prevents another message from being received before a response can be made. The delay after transmitting a call ensures that a response is heard instead of another message occurring on some other channel.

Separate delay times are programmable for Radio Wide and Standard scanning. With radio wide and conventional standard scanning, delays of 0-7.5 seconds are programmable in 0.5-second steps. With SMARTNET/SmartZone and P25 Trunked standard scanning, a scan delay of 2-10 seconds can be programmed in 0.5-second steps.

4.8.5 TRANSMITTING IN THE SCAN MODE

When the transmitter is keyed while scanning is enabled, the transmission may occur on various channels as follows.

Conventional Operation - Transmissions can be programmed to occur on the priority, selected, or receive channel. Refer to Section 5.11 for more information.

SMARTNET/SmartZone/P25 Trunked Operation - If scanning is halted to receive a message, programming determines if transmissions occur on the selected or active channel. Transmissions at other times occur on the selected channel.

4.8.6 NUISANCE CHANNEL ADD/DELETE

With standard scanning, channels can be temporarily deleted from the scan list, for example, if messages become annoying. This feature is not available with radio wide scanning. Channels can also be permanently added or deleted from a scan list as described in Section 4.9.5. Proceed as follows to temporarily delete a nuisance channel:

NOTE: The selected channel and also priority channels cannot be deleted from the scan list.

1. While receiving a message on the channel to be deleted, press and hold the Scan option switch until a tone sounds (about 1 second).

2. The channel is then deleted and scanning of the remaining channels in the scan list resumes.

3. Deleted channels are added back into the scan list if any of the following occur:

   - Scanning is turned off and then on again using the Scan option switch or menu parameter.
   - Transceiver power is turned off and then on again.
   - The selected channel is changed.

4.9 SCAN LISTS

4.9.1 STANDARD MODE SCAN LISTS

NOTE: The selected channel is always scanned.

A scan list is simply the channels that are scanned when scanning is enabled. With all operating modes, as many standard scan lists as are required can usually be programmed (up to 256). The only limitation is the available memory. Each scan list can include up to 256 channels/talk groups (or optionally up to 512). Refer to Sections 4.9.4 and 4.9.5 which follow for information on selecting and editing standard scan lists.

4.9.2 RADIO WIDE SCAN LIST

With radio wide scanning, there is only one scan list available regardless of the type of channel selected, and it is not user programmable. This scan list can contain up to 16 channels of any type. For example, it could include six conventional channels and ten SMARTNET/SmartZone channels.

4.9.3 DETERMINING WHICH CHANNELS ARE IN SCAN LIST

The channels in the radio-wide and conventional scan lists are indicated as follows. Channels in the SMARTNET/SmartZone/P25 Trunked lists are indicated only when editing a scan list.

1. To view the conventional scan list, enable standard scanning using the Scan switch or menu parameter. Likewise, to view the radio wide scan list, enable

radio wide scanning using the Radio Wide Scan switch or menu parameter. Also select the scan list if applicable as described in the following "Selecting a Scan List" description.

2. Select the desired zone and then scroll through the channels by rotating the channel switch. When the displayed channel is in the scan list (scanned normally), the S icon is displayed.

4.9.4 SELECTING A SCAN LIST

NOTE: Only standard scan lists are selectable.

With conventional operation, selecting another conventional channel does not change the scan list. However, the scan list can be temporarily changed by the user if the Scan (List) Select option switch or menu parameter is programmed (see following). The programmed default scan list is automatically reselected on power up.

With SMARTNET/SmartZone operation and Project 25 trunked operation, each channel (talk group) can be programmed to select one of the programmed lists or so that scanning is disabled (No List). In addition, each channel can be programmed so that scanning is automatically enabled (Auto Scan) when it is selected. If the Scan (List) Select option switch or menu parameter is programmed, the list that is selected by all talk and announcement groups in the current system can be temporarily changed by the user as follows. "No List" (scanning disabled) or "Programmed" (default list) can also be selected if desired). The programmed default scan list is automatically reselected on power up.

Change the currently scan list as follows.

1. With scanning disabled (Z icon not displayed), press the Scan List option switch or select the Scan Selct menu parameter.

2. The currently selected list is displayed as "List x", where "x" is the currently selected list. To exit without changing the selected list, simply press the Scan List option switch again or the F1 key.

3. To select another list, press the Up/Down switch. When the desired list is displayed, select it and exit this mode by pressing the Scan List option switch again or the F1 or F2 key.

4.9.5 EDITING A SCAN LIST

If the Scan Edit option switch or menu parameter is programmed, conventional, SMARTNET/ SmartZone, and P25 Trunked standard scan lists can be user programmed as follows. Changes are permanent (cycling power does not reselect a default condition).

1. Make sure that both standard and radio wide scanning are off (Z icon not displayed). Select a conventional or SMARTNET/SmartZone/P25 Trunked channel corresponding to the scan list being programmed.

2. Select the scan edit mode using the Scan Edit option switch or menu parameter. This mode is indicated by in the display.

3. If applicable, select the list to be edited by pressing the Up/Down switch. Select the desired list by pressing the F2 key. The selected list is indicated as "LIST x". If user programming is disabled on a list, (conventional only) "NO EDIT" is momentarily displayed and it cannot be edited.

4. Select the channel you want to add or delete by pressing the Up/Down switch. After the last channel in the current zone is displayed, the first valid channel in the next zone is displayed and vice versa. Lists are limited to 256 channels (or optionally up to 512). If an attempt is made to add more than 256 or 512, "LIST FULL" is displayed and a channel must be deleted before another can be added.

   NOTE: Priority channels can be deleted.

5. If the selected channel is in the scan list (scanned), the S icon is displayed. To change the status of the displayed channel, press the F2 (Enter) switch.

   With conventional channels only, if the selected scan list is programmed with fixed priority channel(s), the next press of F2 makes the current channel the priority channel indicated by P. If dual priority channels are used, pressing F2 again

makes it the second priority channel indicated by F2. Then pressing F2 again takes the channel out of the scan list. Refer to Sections 5.11.3 and 5.11.4 for more information on priority channel sampling.

6. To exit this mode and save the changes, press the F1 (Exit) key or the Scan Edit option switch again.

SECTION 5 CONVENTIONAL MODE FEATURES

5.1 INTRODUCTION

An overview of the conventional operating mode is located in Section 3.8.2. The following information describes the features unique to analog and digital (Project 25) conventional operation. Refer to the preceding "Radio Wide Features" section (4) for information on features common to all operating modes.

5.2 MONITORING BEFORE TRANSMITTING

With conventional operation, you may need to manually monitor the channel before transmitting to make sure that it is not be used by someone else. If you were to transmit while someone else was using the channel, you would probably disrupt their conversation. With SMARTNET/SmartZone and P25 Trunked operation, monitoring is performed automatically. Monitor conventional channels automatically or manually as follows:

Automatic Channel Monitoring

If the selected channel is programmed for Busy Channel Lockout (also called Transmit Disable On Busy), monitoring is performed automatically. Refer to Section 5.4 for more information on this feature.

Manual Channel Monitoring

The automatic monitoring just described may occasionally disable the transmitter when the channel is not in use, such as if the repeater has extended hang time. In this case, you may not want to use it and the channel must then be monitored manually as follows:

Busy Indicator - With scanning disabled, note if the multi-function indicator on the front panel is steady green. If it is not, the channel is not being used and a call can be transmitted. It it is green, a carrier is being detected, so the channel may be busy (see following).

Monitor Mode - There may be times when a busy condition is indicated even though no one is using the channel. Monitoring should then be performed by disabling Call Guard squelch (or group ID detect on Project 25 channels). This is usually done by selecting the Monitor Mode (see following) or by the Normal/Selective option switch or menu parameter (see Section 5.5.5).

5.3 MONITOR MODE

The monitor mode unsquelches the receiver and monitors the channel even if a carrier is not detected. Other features of this mode are as follows:

- Call Guard (CTCSS/DCS) squelch is disabled on analog channels and NAC and group ID detect are disabled on P25 (conventional) channels.
- Busy Channel Lockout is overridden (see next section)
- Scanning temporarily halts

The Monitor Mode operates as follows:

1. To monitor the transmit frequency for activity before transmitting, briefly press the Monitor option switch or select the Monitor menu "Tx Channel" parameter. The icon is then displayed to indicate the monitor mode and the receiver unsquelches.

2. To monitor the receive frequency instead, press and hold the Monitor option switch until a tone sounds or approximately 2 seconds, or select the Monitor menu "Sqlch Ovrd" parameter. This can be used, for

example, to improve reception if intermittent squelching is making a weak message difficult to understand.

3. To disable the monitor mode and return to normal operation, press the Monitor option switch again of select the Monitor menu “Off” parameter.

The Normal/Selective function disables Call Guard squelch and P25 group ID detect but not scanning and P25 NAC detect (see Section 5.5.5).

5.4 BUSY CHANNEL LOCKOUT

The Busy Channel Lockout feature (also called Transmit Disable on Busy) automatically disables the transmitter if the channel is busy when the PTT switch is pressed. When the transmitter is disabled by this feature, “BUSY” is displayed, a busy tone sounds, and the transmitter is disabled.

The Busy Channel Lockout feature can be programmed to operate as follows. Each conventional channel can be programmed differently.

Off - Busy channel lockout is disabled and the transmitter keys even if the channel is busy.

Noise - If a carrier is detected on the channel, the transmitter is disabled when the PTT switch is pressed.

Tone (NAC) - If an incorrect Call Guard (CTCSS/DCS) or NAC code (see Section 5.16) is detected, the transmitter is disabled when the PTT switch is pressed. An incorrect code is any code other than the one programmed for the current channel.

If Busy Channel Override is permitted by programming, it is possible to transmit even when the transmitter is disabled by this feature. Simply release the PTT switch and then quickly press it again.

5.5 CALL GUARD SQUELCH

5.5.1 INTRODUCTION

Tone or digital Call Guard squelch (also called CTCSS/DCS signaling) can be programmed on each conventional analog transmit and receive channel in any order desired. The reverse burst and turn-off code are always transmitted and also detected on channels programmed with Call Guard squelch.

The Call Guard squelch feature eliminates distracting messages intended for others using the channel. This is done by using a subaudible tone or digital code to control the squelch. This tone or code is unique to a user or a group on that channel. This tone or code is transmitted with the voice signal but is not heard because it is in the subaudible range and is attenuated by a filter. Call Guard squelch must be used in both the transmitting and receiving transceiver to be functional.

5.5.2 CALL GUARD SQUELCH ENABLE/ DISABLE

The Normal/Selective option switch or menu parameter (if programmed) can be used to disable receive Call Guard squelch on analog channels or group ID code detection on P25 channels. When selective squelch is disabled, “Sq Normal” is flashed in the display, and when it is enabled, “Sq Select” is flashed.

When “Normal” is selected, the receiver unsquelches only if a carrier is detected, and scanning and Project 25 NAC detection are not disabled. The selected mode is in effect until it is manually changed again. Selecting another channel or cycling power does not reselect a default condition.

5.5.3 TONE CALL GUARD SQUELCH

Tone-type Call Guard squelch utilizes subaudible CTCSS tones from 67-254.1 Hz. Although there are 42 tones assigned, those above 33 (210.7 Hz) are normally not used because of their close proximity to the voice band which starts at 300 Hz. In addition, tones 11 (97.4 Hz), 39 (69.3 Hz), 40 (206.5 Hz), 41 229.1 Hz), and 42 (254.1 Hz) are normally not used because they may cause interference with adjacent tones.

A reverse burst is transmitted when the push-to-talk switch is released and also detected when calls are received. It is a 180-degree phase reversal for a period of time determined by the tone frequency, and it eliminates the squelch tail (noise burst) in the receiving transceiver. Both the transmitting and receiving transceiver must be equipped with this feature for it to be utilized.

5.5.4 DIGITAL CALL GUARD SQUELCH

Digital Call Guard squelch (DCS) uses digital data instead of subaudible tones to control the squelch. This data consists of continuous repetitions of 23-bit words. No bit or word synchronization information is used. When the push-to-talk switch is released, a turn-off code is transmitted which eliminates the squelch tail similar to the reverse burst.

Although there are thousands of possible code combinations with 23 bits, only 83 are unique with the data scheme used. The number specified when the code is programmed is actually a seed for a special algorithm used to generate the 23-bit data word. The data is transmitted at a rate of 134.4 bits per second. Therefore, approximately six words are transmitted each second. When the data is decoded, 23-bit samples are taken and then the bits are rotated to determine if a valid code was received.

5.5.5 SELECTIVE SQUELCH CODE SELECT (CTCSS/DCS/NAC)

NOTE: Call Guard codes can be permanently reprogrammed by keypad programming (see Section 5.17).

A different CTCSS/DCS/NAC squelch code can be temporarily selected if the Selective Squelch option switch or menu parameter and a CTCSS/NAC code list have been programmed. This feature allows the normal transmit and receive Call Guard programming to be temporarily overridden with a code selected from this list.

The CTCSS/DCS/NAC list is programmed with up to sixteen tone (CTCSS) or digital (DCS) Call Guard codes. In addition, for operation on Project 25 channels, each position can be programmed with an NAC code.

When the Call Guard code is changed using this feature, it remains selected even if other channels are selected. However, if transceiver power is cycled or a talk-around channel is selected, the normal codes are reselected. When scanning, the selected code also applies to all scanned channels. If both analog and digital (Project 25) channels can be selected or scanned, the CTCSS/DCS code for the selected position is used for analog channels and the NAC code for the selected position is used for P25 channels. If a channel is programmed for mixed mode operation, the selective squelch type (analog or digital) programmed for the transmit mode determines the selective squelch type used.

Proceed as follows to select a preprogrammed Call Guard code:

1. Press the Selective Squelch option switch or select the Sqlch Code menu mode parameter. Then press the Up/Down switch to select the desired code. The display indicates “SEL SQ xx” where, “xx” is the selected code from 1-16.

2. To select the displayed code and return to the normal display, press the F2 (Select) key or the Selective Squelch switch again.

3. To check which code is selected, press the Selective Squelch switch once to display the current selection and then again to return to normal operation.

4. To return to the normal selective squelch codes, select “DEFAULT” in this mode. As previously described, the normal codes are also automatically reselected whenever transceiver power is cycled or a talk-around channel is selected.

5.6 PENALTY TIMER

A penalty timer may be programmed on conventional systems to prevent transmissions for the programmed time after the time-out timer disables the transmitter (see Section 4.3). The penalty timer can be programmed for the same times as the time-out timer, and timing starts when the PTT switch is released. If the PTT switch is pressed during the penalty time, the time-out indication occurs again and the transmitter remains disabled. When the penalty timer expires, a beep sounds and the transmitter can be keyed.

5.7 CONVERSATION TIMER

A conversation timer can be programmed on conventional systems in addition to the time-out timer (see Section 4.3). This timer limits the total length of a conversation rather than just the length of each transmission as with the time-out timer. The following is more information on this timer.

- It can be programmed for times up to 7.5 minutes.
- It is reset when the time between transmissions exceeds the time programmed for the penalty timer.
- A warning beep sounds 5 seconds before this timer disables the transmitter.
- When this timer disables the transmitter, a continuous tone sounds and the red transmit indicator turns off. The PTT switch must then be released until the penalty timer expires (indicated by a beep).

5.8 REPEATER TALK-AROUND

Normally, all transmissions go through a repeater which usually increases range. However, there may be times when a mobile is out of range of the repeater and therefore unable to talk to anyone even though the mobile being called is only a short distance away. To allow communication in this situation, repeater talk-around can be selected. Transmissions then occur on the receive frequency which permits direct mobile-to-mobile communication.

Repeater talk-around can be selected if the RTA option switch or menu parameter is programmed. When talk-around is enabled by this switch, T_{μ} is displayed. This feature remains enabled during scanning, and changing channels or turning power off does not change the selected condition. Talk-around is available on conventional channels only.

5.9 DISPLAYING TRANSMIT/RECEIVE FREQUENCY

If the Displayed Information option switch or menu parameter is programmed (see Section 4.1), it can be used to display the channel frequency in megahertz. Pressing this switch toggles between displaying the standard channel alias and the channel frequency. The receive frequency is displayed when receiving and the transmit frequency is displayed when transmitting. This feature is available on conventional channels only.

5.10 EMERGENCY ALARM AND CALL

NOTE: The following enhanced conventional emergency features require 5100 operating (Flash) software 1.8.0 or later and PCConfigure 1.19 or later.

5.10.1 INTRODUCTION

Emergency Alarms and Calls are separate functions that can be individually enabled or disabled on each analog and P25 conventional system. The Emergency option switch or menu parameter is required for these functions. Emergency Alarms and Calls are transmitted on the last selected talk group.

The emergency hot microphone function can also be programmed with emergency alarms and calls. Then when the emergency switch is pressed, the microphone audio is enabled and the transmitter automatically keyed for the programmed hot microphone time (10-120 seconds). If “silent” emergency is programmed, no tones sound but the transmit indicator still lights. If the “Surveillance Mode” is enabled (see Section 4.7), all indicators, lights, and tones are disabled.

5.10.2 EMERGENCY ALARMS

An emergency alarm is a special transmission on the selected talk group that alerts a dispatcher of an emergency situation. It is sent by simply pressing Emergency option switch or selecting the Emergency menu parameter on channel of a system programmed for emergency alarms.

In the P25 conventional mode, a special emergency data transmission is sent, and in the conventional analog mode, it is a DTMF number that is sent in place of the Pre/Post ANI programming if applicable. If ANI is not programmed, it defaults to the “Pre” condition. The DTMF Emergency ID is programmed on the Conventional Radio Wide screen when programming the radio. Proceed as follows to activate an emergency alarm:

1. Select a channel of a system on which the Emergency Alarm is enabled and then press the Emergency option switch or select that menu parameter. The radio then begins automatically transmitting an emergency alarm and “EMERGNCY” is indicated in the display for 3 seconds.

2. When the emergency alarm is acknowledged, “ACK RCVD” is briefly displayed and the emergency acknowledge tone (two beeps) sounds. This alert tone can be disabled if desired. Silent operation may

also be programmed in which case no tone sounds and there is no indication that an acknowledgment occurred.

3. The radio continues to transmit this message until an acknowledgment is received or until 30 attempts have been made. To exit this mode, power must be turned off.

5.10.3 EMERGENCY CALLS

An emergency call occurs if the PTT switch is pressed after pressing the Emergency switch or selecting the menu parameter as above and the system of the selected channel is programmed for emergency calls.

If the PTT switch is pressed on a P25 channel, an emergency indication is sent according to the P25 standard (the emergency bit is set in the Common Air Interface). If it is pressed on an analog channel, the DTMF emergency ID is sent in place of the ANI DTMF PTT ID if applicable. To place this call, proceed as follows:

1. Select a channel of a system on which the Emergency Call is enabled and press the Emergency option switch or select that menu parameter.

2. To place the emergency call, manually press the PTT switch and begin speaking as with a standard call. If the channel is changed, operation continues on the new channel in the emergency mode.

3. To exit this mode, power must be turned off.

5.11 CONVENTIONAL MODE SCANNING

5.11.1 GENERAL

Channel scanning features common to all operating modes are described in Sections 4.8 and 4.9. The following information describes features unique to conventional operation.

5.11.2 TRANSMITTING IN SCAN MODE

Each conventional scan list can be programmed for one of the following modes. These modes determine if priority sampling occurs and also the channel on which transmissions occur while scanning. Refer to the next section for more information on priority sampling.

No Priority - No priority channel sampling occurs when the list is selected. The radio transmits on the selected channel.

Priority/Tx Selected - Priority sampling occurs and the priority channel or channels are those programmed in the selected scan list. The radio transmits on the selected channel.

Priority/Tx Priority (1) - Priority sampling occurs and the priority channel or channels are those programmed in the selected scan list. The radio transmits on the priority (1) channel.

Priority (1) on Selected - The priority (1) channel is always the selected channel. The radio transmits on the selected channel.

Talkback - No priority sampling occurs. The radio transmits on the channel of a call while scanning is halted. Then once scanning resumes, it transmits on the selected channel.

5.11.3 PRIORITY CHANNEL SAMPLING

NOTE: The following describes priority sampling when scanning conventional channels. Priority sampling when scanning SMARTNET/SmartZone/P25 Trunked channels is described in Section 6.12.

General

The priority channel sampling feature ensures that when standard scanning, messages on the priority channel are not missed while listening to a message on some other channel. The transceiver can be programmed as just described so that the priority channel is a fixed channel programmed in the current scan list, the currently selected channel, or not used.

NOTE: Priority channel sampling (both analog and P25 channels) currently does not occur when receiving P25 or encrypted calls. In addition, the priority channel is not scanned if the active channel is an analog channel on the same frequency programmed with CTCSS/DCS squelch control.

Either a single or dual priority* channels can be programmed if desired. With dual priority, a call on the second priority channel is interrupted by a call on the first priority channel but not vice versa. When scanning and the selected channel is a single or first priority channel, P is indicated in the display. This indication is displayed regardless of whether the priority channel is fixed or always the selected channel. When it is a second priority channel, P2 is displayed.

The priority channel sampling frequency is determined by the programmed Priority Lookback Time A (see description which follows). For example, if 2.0 seconds is programmed, the priority channel is sampled every 2.0 seconds when listening to a message on a non-priority channel. When not listening to a message, the priority channels are scanned in the normal scan sequence. With dual priority, the first and second priority channels are alternately sampled at the Lookback Time.

Priority channel sampling occurs only with standard conventional scanning. It does not occur with radio-wide scanning, when listening to any type of SMARTNET/SmartZone/P25 trunked call, P25 conventional call, encrypted call, or when transmitting (see preceding note). A series of "ticks" may be heard when the priority channel is sampled while listening to a message on some other conventional channel.

The priority sampling times are programmed by the following parameters:

Lookback Time A - This time determines how often the priority channel is checked for activity. Times of 0.25-4.00 seconds in 0.25-second steps can be programmed.

Lookback Time B - This time determines how often the priority channel is checked once an incorrect Call Guard (CTCSS/DCS) or NAC code is detected. Since it takes much longer to detect an incorrect Call Guard signal than a carrier, this time should be relatively long to prevent the interruptions from making a message difficult to understand. Times of 0.5-8.0 seconds can be programmed in 0.5-second steps.

5.11.4 CHANGING THE PRIORITY CHANNEL

If a fixed priority channel is associated with the current scan list, it can be changed if the Priority option switch or menu parameter is programmed. With dual priority, this function changes only the first priority channel. To change both priority channels, use the Scan List Edit function described in Section 4.9.5.

Proceed as follows to change the priority channel using the Priority option switch/menu parameter:

1. Make sure scanning is disabled (Z icon not displayed) and the desired scan list is selected (see Section 4.9).

2. Select the channel you want to be the priority channel and then press the Priority option switch or select that menu parameter. "Priority" is then flashed to indicate that the current channel is now the priority channel when scanning that list. Other indications that may occur are as follows:

   - If "No Priority" is displayed, priority sampling may not be enabled on the scan list.

   - If "Sel Chan" is displayed, the priority channel is always the selected channel and cannot be changed.

   - If no indication displayed, the scan list may not be user editable or the channel may not be in the scan list.

5.12 STANDARD CONVENTIONAL CALLS

Standard conventional calls are placed to other mobile units monitoring the selected channel. The proper coded Call Guard squelch tone or code or P25 NAC may need to be transmitted by your radio for them to receive a call (see Sections 5.5 and 5.16.3).

Placing a Standard Conventional Call

1. Turn power on and set the volume as described in Section 3.1. Select the channel programmed for the mobile you want to call as described in Section 3.3.

2. Monitor the channel automatically or manually as described in Section 5.2.

** This feature requires 51xx operating (Flash) software 1.5.0 or later and PCConfigure 1.17 or later.*

3. Press the PTT switch and if the Busy Channel Lockout feature is programmed on the channel (see Section 5.4), the transmitter is automatically disabled if the channel is busy. Otherwise, busy and out-of-range conditions are not indicated.

4. Press (and hold) the PTT switch to talk and release it to listen.

Receiving a Standard Conventional Call

1. Select or scan the channel programmed for the call you want to receive (refer to Sections 4.8 and 4.9 for more scanning information).

2. When the call is received, press the PTT switch to talk and release it to listen. If scanning, responses may occur on the priority, selected, or receive channel as described in Section 5.11.2.

5.13 DTMF/ANI SIGNALING

DTMF (Dual Tone Multi-Frequency) tones can be generated for ANI (Automatic Number Identification) and other purposes on conventional analog channels. One of the following options may be enabled on each channel:

Pre-Tx ANI - A preprogrammed ANI sequence is automatically sent each time the PTT switch is pressed.

Post-Tx ANI - A preprogrammed ANI sequence is automatically sent each time the PTT switch is released.

When an emergency alarm or call is placed, this ANI signaling is replaced by the Emergency DTMF ID (see Section 5.10).

5.14 CLONE MODE

The Clone feature* enables one radio to program another with identical information. The PCConfigure programming software is not required. Currently, this feature is available with 51xx portables only. Other requirements are as follows:

- The Clone menu parameter must be selectable by the master (sending) radio. This parameter is not required with the slave (receiving) radio.

- The master and slave radios must be identical models (same frequency range and options).

- Flash code Version 1.5.0 or higher is required with both radios (the version number is display briefly at power up). PCConfigure Version 1.17 or higher is also required to program the Clone menu parameter.

Only zones with conventional analog and P25 channels can be transferred using this function. Any SMARTNET/SmartZone and P25 trunked information is not transferred. In addition, the P25 Unit ID, encryption keys, and the RSI ID and other OTAR information is not transferred. Cloned zones are indicated in the slave radio by an asterisk in the first character position of the zone alias.

Proceed as follows to program a radio using this feature:

1. Turn the slave (receiving) radio off and connect it to the master (sending) radio using Cloning Cable, Part No. 023-5100-930. Turn the slave radio back on.

2. On the master radio, select the Clone menu parameter and press the F2 key. Either the “Zone” or “Complete” mode can then be selected. Operation in these modes is as follows:

   Zone - This mode allows channel information for only the selected zones to be transferred. Information programmed on the Global, Radio Wide, and By System screens is not changed. A list of the available conventional zones is displayed, and then to select a zone, highlight it and press the F2 key. A selected zone is indicated by an asterisk (*). After the desired zones are selected, scroll to “OK” and press F2 to begin the data transfer.

   Complete - This mode transfers all conventional programming information from the master radio. This includes information on the Global, Radio Wide, and By System screens. Simply highlight “Complete” and press the F2 key to begin the data transfer.

** This feature requires 51xx operating (Flash) software 1.5.0 or later and PCConfigure 1.17 or later.*

5.15 SINGLE TONE ENCODER

This feature allows the user to transmit a single tone by pressing the Single Tone Encoder option switch or selecting that menu parameter. Each conventional system can be programmed for a tone of 500-2500 Hz in 1 Hz steps with a duration of 0.5-2.5 seconds in 0.1 second steps. This feature is available only with Flash code 1.7.0 or later.

5.16 PROJECT 25 MODE FEATURES

5.16.1 UNIT ID CODE

Each transceiver that operates on Project 25 (digital) channels is programmed with an eight-digit unit ID. This ID is unique for each transceiver and can be any number from 1-16,777,216. When power is turned on with a Project 25 channel selected, this ID is briefly displayed.

5.16.2 GROUP ID CODE

Each Project 25 channel is programmed with a group ID that determines which group of mobiles will receive the call. A call is received on a channel if a selected or scanned channel is programmed with that ID and the correct NAC is detected (see following). Group IDs can be any number from 0-65,535. Group ID detect can be disabled by the Normal/Selective squelch function described in Section 5.5.2 or the monitor mode described in Section 5.3

5.16.3 NETWORK ACCESS CODE

Project 25 conventional channels also use a NAC (Network Access Code) to control which calls are received on a channel. The NAC can be 0-4095, and each transmit and receive channel can be programmed for a different code. Other operation, such as monitoring before transmitting, is similar to that of analog channels. NAC (and group ID) detect can be disabled by the monitor mode described in Section 5.3.

5.16.4 P25 GROUP CALLS

P25 group calls are placed by simply selecting the channel programmed for the desired group, monitoring the channel if required, and transmitting.

Changing a Channel Talk Group

If the Digital Talk Group Select option switch or Select TG menu parameter is programmed, the talk group assigned to a channel can be changed by the user. The new talk group continues to be assigned to the channel until it is manually changed again (cycling radio power or selecting another channel does not reselect a default talk group). Change the talk group assigned to a channel as follows:

1. Select the channel to be changed and then press the Talk Group Select option switch or select the Select TG menu parameter.

2. Press the Up/Down switch until the alias (alphatag) of the desired talk group is displayed.

3. To select that talk group and return to normal operation, press the Talk Group Select option switch again or the F2 switch. If talk group selection has been disabled on the channel by programming, “NO LIST” is displayed, a tone sounds, and no change occurs.

5.16.5 P25 UNIT CALLS

Unit Calls (also called Individual Calls) can be placed to a specific radio on a Project 25 channel if the Unit Call option switch or menu parameter is programmed. Only the individual ID of the target radio is sent (a talk group ID is not sent). The mobiles that can be called are preprogrammed in the unit call list.

To receive a Unit Call, the RF channel of the call must be selected or scanned and the correct NAC and unit ID must be detected. The ID of the calling mobile is then transmitted back. To respond to the call, the transceiver must be programmed with the Unit ID option switch or menu parameter, and have a Unit Call programmed for the ID of the calling mobile.

Place and receive a Unit Call as follows:

1. To transmit a Unit Call, press the Unit Call option switch or select the Unit Call menu parameter. The alias (tag) of the last Unit Call is displayed.

** This feature requires 51xx operating (Flash) software 1.9.0 or later and PCConfigure 1.20 or later.*

2. If required, press the Up/Down switch to display the desired call. The alias and ID of the calls that have been programmed are alternately displayed.

3. Press and then release the PTT switch. Ringing is then heard and "WAIT" displayed to indicate that the mobile is being rung. To disable this ringing but not the call, briefly press the PTT switch again. Ringing occurs for 20 seconds or until the call is answered, whichever occurs first.

4. When a Unit Call is received, two beeps sound (if tones are enabled), and "Call Rcvd" and the alias or frequency of the currently selected talk group are alternately flashed.

   In addition, the transceiver can be programmed to display the alias of the talk group on which the call is being received (if it is not the same as the selected talk group) and/or the ID of the mobile placing the call. The time each is displayed is programmable** for 0.5-7.0 seconds or infinite.

5. To respond, select the Unit Call mode by pressing the Unit Call option switch or selecting the menu parameter. The following operation then occurs:

   - If a unit call has been programmed with the ID of the calling mobile, it is automatically selected. A response can then be made without changing the selected channel.

   - If no Unit Call has been programmed with the ID of the calling mobile, a response cannot be made in this mode.

   - If the call timer times out (set by programming) or the channel is changed before a response is made, the unit call mode is exited.

5.16.6 CALL ALERT

General

The Call Alert™ feature* allows pages to be sent and received on P25 conventional channels. Operation is similar to SMARTNET/SmartZone and P25 Trunked channels.

Answering a Page

1. When a page is received, five beeps sound and "PAGE" is displayed. The ID of the mobile paging you is stored as the last ID received.

2. To clear or ignore the page, press any option switch. If the PTT switch is pressed, a group call is placed on the selected channel.

3. To answer the page as a unit call (see Section 5.16.5), press the Unit Call option switch or select that menu parameter and the alias of the mobile paging you is displayed. Press the PTT switch and respond. One of the following conditions then occur:

   - If the mobile being called is on the air, ringing is heard until the called party answers or for 20 seconds, whichever occurs first. If no answer occurs within 20 seconds, a continuous tone sounds and "NO ANS" is displayed.

   - If the mobile being called is not on the air, a continuous tone is heard instead of ringing and "NO ACK" is displayed.

4. When the call is finished or if it could not be completed for some reason, end it by pressing the Unit Call option switch or the F1 (Exit) key.

Initiating a Page

1. With a P25 conventional channel selected, momentarily press the Call Alert option switch or select that menu parameter. The alias of the last ID called is displayed.

2. If required, press the Up/Down switch to display the desired mobile. The alias of each number is displayed.

3. Press the PTT switch or the F2 key and one of the following occur:

   - If five beeps sound, the system received the page and the paged mobile is on the air and received it. The page mode is automatically exited.

** This feature requires 51xx operating (Flash) software 1.8.0 or later and PCConfigure 1.19 or later.*

*** This feature requires 51xx operating (Flash) software 1.9.0 or later and PCConfigure 1.20 or later.*

- If the system received the page but the called mobile is not on the air, a single beep sounds and "NO ACK" is displayed 6 seconds after the PTT switch is pressed. Auto exit then occurs.

5.16.7 MESSAGING

The messaging feature* allows preprogrammed messages to be sent to a dispatcher on P25 channels. Up to 16 messages can be preprogrammed, and they are identified by an alias. If a Message option switch or menu parameter is programmed, messages are sent as follows:

1. Momentarily press the Message option switch or select that menu parameter. The alias of the last message sent is displayed.

2. If required, press the Up/Down switch to display the desired message. Then send the message by pressing the F2 key or momentarily pressing the PTT switch. One of the following events then occurs:

   - If five beeps sound and "ACK RECVD" is displayed, the message was received and automatically acknowledged by the system.

   - If after five tries the message is not acknowledged, a tone sounds and "NO ACK" is displayed.

5.16.8 STATUS MESSAGING

The status feature* allows you to manually or automatically send your current status to your dispatcher on P25 channels. Up to eight status conditions can be preprogrammed, and they are identified by an alias. If the Status option switch or menu parameter is programmed, status conditions are sent as follows:

1. Momentarily press the Status option switch or select that menu parameter. The alias of the current status condition is displayed.

2. To change the current status, press the Up/Down switch until the desired status is displayed. Then to send the status, press the F2 (Select) switch or momentarily press the PTT switch. One of the following events then occurs:

   - If five beeps sound and "ACK RCVD" is displayed, the status was received and acknowledged by the system.

   - If after five tries the message is not acknowledged, a tone sounds and "NO ACK" is displayed.

5.17 KEYPAD PROGRAMMING

NOTE: The Keypad programming feature is available to Federal Government users only. Users regulated by the Federal Communications Commission are not allowed to have this feature.

5.17.1 INTRODUCTION

Keypad programming can be enabled only with transceivers that have been factory coded as Federal models. It is then available if a conventional mode option switch or menu parameter is programmed for the "Keypad Programming" function. The keypad programming mode is indicated by "CHNG ZONE" and  in the display.

Keypad programming allows conventional channel parameters such as the transmit and receive frequency and Call Guard squelch code to be changed. In addition, several conventional mode timers can be changed. It cannot be used to reprogram disabled channels or any SMARTNET/SmartZone/P25 Trunked information.

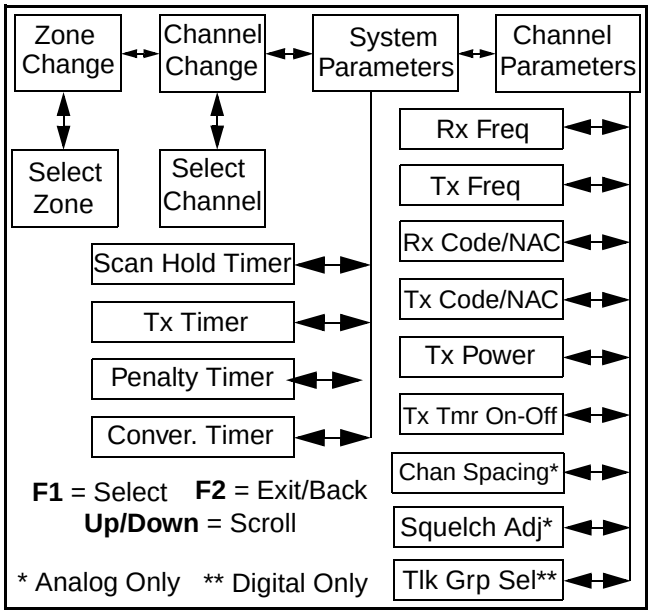

Figure 5-1 Keypad Programming Menu Flowchart

** This feature requires 51xx operating (Flash) software 1.8.0 or later and PCConfigure 1.19 or later.*

5.17.2 MENU DESCRIPTION

A menu system is used to select parameters in the keypad programming mode. A flowchart showing the keypad programming mode menu structure is located in Figure 5-1. When the keypad programming mode is selected by the Keypad Programming option switch or menu parameter, the first menu parameter "CHNG ZONE" is displayed as just described. Press the Up/Down switch to scroll through the available parameters which are listed below.

- **CHNG ZONE**
- **CHNG CHAN**
- **SYS PARMS**
- **CHAN PARMS**

Press the F2 (Select) key to select a highlighted parameter, and press the F1 key from one of the main menus to exit keypad programming. Pressing it in the other menus returns to the previous menu. Additional information on this parameters is located in the following sections.

5.17.3 ZONE PASSWORD

NOTE: *Make sure that the zone password(s) are not lost because they cannot be overridden in the field. The PCConfigure software must be used to display the lost password or program a new password.*

Each zone can be programmed with a password by the PCConfigure software to prevent unauthorized reprogramming of zone by keypad programming. When this password is programmed, it must be entered before system or channel parameters in that zone can be changed by keypad programming. The zone password is programmed in the Zones > Edit Zone screen of the PCConfigure programmer. This screen is displayed by clicking the Edit Zone button. A different password can be programmed for each zone.

When an attempt is made to select a system or channel parameter in a password protected zone, "PASSWORD" is flashed. The password is always eight digits long and is entered using the same procedure as used for the power-up password described in Section 3.2. After the password is entered, system and channel parameters for that zone can be reprogrammed normally.

5.17.4 ZONE CHANGE PARAMETER

The "CHNG ZONE" menu parameter selects the zone containing the conventional channel to be reprogrammed. It does not change the zone selected for normal operation.

Press the F2 switch to select the "ZONE CHG" parameter and then scroll through the programmed zones by pressing the Up/Down switch. When the desired zone is displayed, select it by pressing the F2 switch.

5.17.5 CHANNEL CHANGE PARAMETER

The "CHNG CHAN" menu parameter selects the conventional channel to be reprogrammed. Disabled or SMARTNET/SmartZone/P25 Trunked channels cannot be selected. This does not change the channel selected for normal operation.

Press the Select switch to select the "CHNG CHAN" parameter and then scroll through the programmed channels by pressing the Up/Down switch. When the desired channel is displayed, select it by pressing F2 switch.

5.17.6 SYSTEM PARAMETERS

NOTE: If "PASSWORD" is briefly displayed when attempting to select a parameter, see Section 5.17.3.

The "SYS PARMS" menu parameter selects the conventional mode timers to be reprogrammed (see following). Press the F2 switch to select the "SYS PARMS" parameter and then press the Up/Down switch to display the desired parameter. Then press the F2 switch again to select it.

SCAN TIMER - Selects the Scan Hold timer. Press the Up/Down switch to increment/decrement the timer in 0.5-second steps or set it to 0 seconds to disable it. When the desired value is displayed, store it by pressing the F2 switch.

TX TIMER - Selects the transmit time-out timer. Press the Up/Down switch to increment/decrement the timer in 15-second steps or disable it by selecting 0 seconds. When the desired value is displayed, store it by pressing the F2 switch.

PEN TIMER - Selects the penalty timer. Press the Up/Down switch to increment/decrement the timer in 15-second steps. When the desired value is displayed, store it by pressing the F2 switch.

CONV TIMER - Selects the conversation timer. Press the Up/Down switch to increment/decrement the timer in 30-second steps or disable it by selecting 0 seconds. When the desired value is displayed, store it by pressing the F2 switch.

5.17.7 CHANNEL PARAMETERS

NOTE: If "ENTER PSWD" is briefly displayed when attempting to select a parameter, see Section 5.17.3.

The "CHAN PARMS" menu parameter selects the following conventional channel parameters that can be reprogrammed. Press F2 switch to select the "CHAN PARMS" parameter and then press the Up/Down switch to display the desired parameter. Then press the F2 switch to select it. The squelch control parameters are unique to the type of conventional channel selected (analog or Project 25).

RX FREQ - Programs the receive channel frequency. The digit being changed flashes, and press the Up/Down switch to select the desired number for that digit. Then press the F2 switch to move to the next digit. If an invalid frequency is entered, a beep sounds, "INVALID" is briefly displayed, and the number must be re-entered.

TX FREQ - Programs the transmit frequency the same as the preceding RX FREQ.

CTCSS/DCS Squelch Control (Analog Channel)

RX CODE - Programs the receive Call Guard (CTCSS/DCS) code. The currently selected code and is initially displayed. Press the Up/Down switch to select the desired code type (CTCSS analog or DCS digital Call Guard). Then press F2 to select it and enter the code number similar to programming a channel frequency as just described.

TX CODE - Selects the transmit codes the same as RX CODE above.

NAC Squelch Control (Project 25 Channel)

RX NAC - Programs the Network Access Code (NAC) which can be any number from 0-4095. The procedure is similar to programming a RX FREQ just described. If an invalid code is entered, a beep sounds, "INVALID" is briefly displayed, and the code must be re-entered.

TX NAC - Selects the transmit NAC the same as RX NAC above.

TX POWER - Selects the desired power output level. Press the Up/Down switch to scroll through the following choices. When the desired setting is displayed, store it by pressing the F2 switch.

- POWER HI - High transmit power
- POWER LO - Low transmit power
- POWER SW - Switchable power selectable by the High/Low power switch. This choice is not available if that switch is not programmed.

TX TIMER - Enables or disables the time-out timer on the current channel. Press the Up/Down switch to select the on and off mode, and when the desired setting is displayed, store it by pressing the F2 switch.

CHAN SPC (Analog Only) - Selects either wide or narrow band channel spacing. Press the Up/Down switch to select "WIDE" or "NARROW", and when the desired setting is displayed, store it by pressing the F2 switch.

SQ ADJ (Analog Only) - Changes the preset squelch setting on that channel. The default setting is "0" and values of –7 to +7 can be selected. Increasing this setting toward +7 causes the squelch to open sooner so that weaker signals can be received, and decreasing it toward –7 causes the opposite to occur.

NOTE: The channel spacing is not set with P25 channels because it is always narrow, and the squelch cannot be changed because the setting is critical for proper receiver operation.

TG ID (P25 Only) - Selects the talk group for the selected channel. Press the Up/Down switch to display the alias of each preprogrammed talk group and then store it by pressing the F2 switch.

SECTION 6 SMARTNET/SMARTZONE/P25 TRUNKED FEATURES

6.1 INTRODUCTION

An overview of the SMARTNET/SmartZone and P25 Trunked operating modes is located in Section 3.8. The following information describes the features unique to these modes of operation. Refer to the "Radio Wide Features" section starting on page 16 for information on features common to all operating modes.

6.2 ANALOG AND DIGITAL OPERATION

Either analog or digital operation can be selected for communication on SMARTNET traffic channels. Each talk group can be programmed for either type of operation. Digital operation may be an optional feature.

6.3 VIEWING UNIT ID

When power is turned on with a SMARTNET/ SmartZone channel selected, the five-digit Unit ID from 1-65,535 is briefly displayed as IDxxxxx. When a P25 channel is selected, the eight-digit unit ID from 1-16,777,216 is briefly displayed (see Section 5.16.1).

6.4 STANDARD GROUP CALLS

6.4.1 INTRODUCTION

Standard group calls may be placed to another mobile, group of mobiles, or a dispatcher, depending on programming. Most calls are probably this type. Proceed as follows to place and receive group calls:

6.4.2 PLACING A STANDARD GROUP CALL

1. Turn power on and set the volume as described in Section 3.1. Select the channel programmed for the talk group you want to call (see Section 3.3).

2. If the talk group is programmed for encryption and is not strapped to Clear or Coded, select the desired mode by pressing the Clear/Secure option switch or selecting that menu parameter. The status cannot be changed if the talk group is strapped to Clear or Coded. Refer to Section 8.1.6 for more information.

3. Press the PTT switch and begin talking. An optional talk permit tone may sound to indicate when talking can begin. Events that may occur are as follows:

   - If in the secure mode and your transceiver is not programmed with the proper encryption key, "KEYFAIL" is displayed and the call must be made in the clear mode or the proper key must be programmed.

   - If the busy tone sounds and "BUSY" is displayed, the system is busy. Release the PTT switch and wait for the call back tone to sound. Then press the PTT switch within 3 seconds.

   - If a continuous tone sounds and "NO SYS" is displayed, you may be out-of-range. Drive closer or away from shielding objects and try again.

   - If your unit ID is invalid, the call is being made to an invalid group ID, or group calls are not enabled, "DISABLED ID" is displayed and an alert tone sounds.

   - If an attempt is made to change an analog call from the clear to secure mode and there is no available secure channel, "NO SEC" is flashed, an error tone sounds, and the call is terminated.

   - If an attempt is made to change an analog channel from the secure to clear mode, "SEC ONLY" is displayed, an error tone sounds, and the call is terminated. (Calls on digital channels can be changed if not strapped to clear or secure.)

   - If the secure mode is selected by the Secure/Clear option switch or menu parameter and an attempt is made to transmit on a channel strapped as clear, "Clear Only" is displayed and the transmitter is disabled. Likewise, if the clear mode is selected and the channel is strapped as secure, "Secure Only" is displayed and the transmitter is disabled.

6.4.3 RECEIVING A STANDARD GROUP CALL

Calls are received on only the talk group and/or announcement group programmed for the selected

channel (with scanning disabled). When the selected channel is programmed with both Talk and Announcement groups, only the Talk and Announcement group IDs are detected. Other IDs in the Announcement group are detected only if no talk group is programmed.

The display indicates the selected channel alias when a call is received. The transceiver can also be programmed so that the received talk group alias and/or Individual ID of the calling mobile are displayed. The received talk group alias and the selected talk group alias are alternately displayed if they are different, and the Individual ID of the calling mobile is displayed briefly when the call is received. The time each is displayed is programmable* for 0.5-7.0 seconds or infinite.

6.5 PRIVATE (UNIT-TO-UNIT) CALLS

NOTE: With P25 Trunked operation, these calls are called Unit Calls, and they function the same as Enhanced Private Conversation calls described in the following information.

6.5.1 GENERAL

Private calls allow calls to be placed to a specific mobile unit. Either the Enhanced Private Conversation™ or standard Private Conversation modes may be programmed depending on the capabilities of the radio system. One difference between these call types is that the Enhanced type provides an indication that the called mobile is not on the air and the standard version does not. Operation in each of these modes is described in the following information.

The Private Call option key is required to place these calls, and either that key or the Call Response option key is required to receive them. Private calls are programmed to operate in one of the following modes:

- Disabled
- Answer-only capability
- List only - Unit IDs can be selected from a preprogrammed list only (direct entry using the keypad is not allowed)
- Unlimited - Unit IDs can be selected from a list and also dialed directly entered using the keypad.

Both limited and DTMF keypad models can be programmed to recall the unit IDs from a preprogrammed list. However, only DTMF keypad models can be programmed to directly dial unit IDs.

6.5.2 PLACING AN ENHANCED PRIVATE CONVERSATION CALL

Recalling From List

1. Momentarily press the Private Call option key or select that menu parameter and the alias of the last called mobile is displayed. The private call mode is indicated by  in the display.

2. If required, select another mobile by pressing the Up/Down switch until the alias of the desired mobile is displayed.

3. Press the PTT switch of the F2 key to initiate the call.

(Proceed to the bulleted list which follows Item 3 in the next section for events that may occur next.)

Direct Entry Using DTMF Keypad

1. Press and hold the Private Call option key until a tone sounds (approximately 1 second). The last ID called is displayed, and the private call mode is indicated by  in the display.

2. Using the 0-9 keys, dial the ID of the mobile you are calling (five digits must be entered). To erase the last digit, press the Down key, and to cancel the call, press the Private Call Option key again.

3. Press the PTT switch to initiate the call. If the entered number is valid, the display indicates the alias of the ID if it matches an ID in the call list. Otherwise, the ID you entered continues to be displayed.

   Events that may then occur are as follows:

   - If the mobile being called is on the air, “WAIT” is displayed and ringing is heard until the called party answers or for 20 seconds, whichever occurs first. Pressing the PTT switch or an option key

** This feature requires 51xx operating (Flash) software 1.9.0 or later and PCConfigure 1.20 or later.*

stops the ringing but not the call. When the call is answered, the voice of the called party is heard.

- If the called mobile does not answer within 20 seconds, a continuous tone sounds and "NO ANS" is displayed.
- If the called mobile is not on the air, a continuous tone sounds instead of the ringing tone and "NO ACK" is displayed.
- If the busy tone sounds and "BUSY" is displayed, the called mobile has answered the call but the system is busy. When the system is no longer busy, the call back tone sounds.
- If your transceiver or the called transceiver is inhibited or not programmed to make this type of call or for the requested secure mode, "Rspns Only" is displayed and an alert tone sounds.
- If your transceiver does not have the proper encryption key, "KEYFAIL" is displayed and the call must be made in the clear mode by pressing the Clear/Secure option key (if strapped to switchable). Otherwise, load the correct key.

4. When the call is finished or is not answered, end it by pressing the Private Call option key or the F1 (Exit) key.

6.5.3 PLACING A STANDARD PRIVATE CONVERSATION CALL

Recalling From List

1. Momentarily press the Private Call option key or select that menu parameter. The alias of the last called mobile is displayed, and the private call mode is indicated by  in the display.
2. If required, select another mobile by pressing the Up/Down switch until the alias of the desired mobile is displayed.
3. Press the PTT switch or the F2 key to initiate the call.

(Proceed to the bulleted list which follows Item 3 in the next section for events that may occur next.)

Direct Entry Using DTMF Keypad

1. Press and hold the Private Call option key until a tone sounds (approximately 1 second). The last ID called is displayed, and the private call mode is indicated by  in the display.
2. Using the 0-9 keys, dial the ID of the mobile you are calling (all six digits). To erase the last digit, press the Down key, and to cancel the call, press the Private Call Option key again.
3. Press the PTT switch to initiate the call. If the entered number is valid, the display indicates the alias of the ID if it matches an ID in the call list. Otherwise, the ID you entered continues to be displayed.

   Events that may then occur are as follows:

   - The called party answers the call.
   - The called party does not answer. Press the Private Call option key or F1 (Exit) to end the call.
   - If the selected mobile ID is not valid, "INVALID ID" is displayed and an alert tone sounds.
   - If the radio system is busy, four low tones sound and "BUSY" is displayed. When the system is no longer busy, the call back tone (four beeps) is heard and the channel is automatically acquired. Press the PTT switch to continue the call.
   - If the call is in the secure mode and the transceiver does not have the proper encryption key, "KEYFAIL" is displayed and the call must be made in the clear mode by pressing the Clear/Secure option key or selecting that menu parameter (if strapped to switchable). Otherwise, load the correct key.

4. When the call is finished or if it is not answered, end it by pressing the Private Call option key or the F1 (Exit) key.

6.5.4 RECEIVING A PRIVATE CALL (ALL TYPES)

1. When a private call is received, “CALL RCVD” is displayed and the call tone sounds once.

2. To answer the call, press the Private Call option key or select that menu parameter and then press the PTT switch and begin speaking. The unit ID of the calling mobile is displayed. More information follows:

   - If the PTT switch is pressed before the Private Call option key, the call is transmitted as a group call.

   - If private calls are not permitted (the Private Call option key/menu parameter is not programmed), press the Call Response option key or select that menu parameter to answer the call.

   - The call must be answered within 20 seconds or it is automatically terminated.

   - If the system is busy when a response is made, “BUSY” is displayed and the busy tone sounds.

6.6 TELEPHONE CALLS

NOTE: Telephone calls are currently not available in the P25 trunked mode or any secure mode.

6.6.1 GENERAL

The telephone call feature allows telephone calls to be placed and received over the public telephone system using your transceiver. Telephone calls are programmed to operate in one of the following modes:

- Disabled
- Answer-only capability
- List only - Telephone numbers can be selected from a preprogrammed list only (direct entry using the keypad is not allowed)
- Unlimited - Telephone numbers can be selected from a list and also dialed directly entered using the keypad.

Both limited and DTMF keypad models can place telephone calls by recalling the telephone number from a preprogrammed list as just described. However, only DTMF keypad models can directly dial telephone numbers using the keypad.

6.6.2 PLACING A TELEPHONE CALL

Recalling From List

1. Momentarily press the Phone option key or select that menu parameter. The alias of the last called telephone number is displayed. The interconnect call mode is indicated by ☎ in the display.

2. If required, press the Up/Down switch to display the desired number. The alias of each number is displayed.

3. Press and release the PTT switch and “DIALING” is displayed. Events that may occur are as follows:

(Proceed to the bulleted list which follows Item 3 in the next section for events that may occur next.)

Direct Entry Using DTMF Keypad

1. Press and hold the Phone option key until a tone sounds (approximately 1 second). The alias of the last called telephone number is displayed if it is in the phone number list. Otherwise, the last eight digits of the last called telephone number are displayed. The interconnect call mode is indicated by ☎ in the display.

2. Enter the telephone number using the 0-9, *, and # keys. To enter a pause (indicated by “P”), press * and then #. To erase the last digit, press the F1 key. The number scrolls to the left in the display so that the eight right-most digits are always displayed. Numbers up to sixteen digits (including pauses) can be entered. Press the Phone option key to cancel the call.

3. Press and release the PTT switch and “DIALING” is displayed. Events that may occur are as follows:

   - If the access is successful, a dial tone sounds and the dialed number is displayed and sent. Either ringing or a busy signal is then heard as with a standard telephone call. When the called party answers, press the PTT switch to talk and release it

to listen (since the transceiver is half-duplex, it is not possible to talk and listen at the same time). Each time the PTT switch is released, a go-ahead tone is sent to the landside party to indicate when they can respond. To dial a number after the connection is made, press the PTT switch and dial the number using the microphone keypad.

- If the selected telephone number is not valid, "INVALID" is displayed and an alert tone sounds. Select a valid number.

- If the system is busy, "BUSY" is displayed and the busy tone sounds. The call will automatically proceed when the system becomes available.

- If you are out-of-range or the radio cannot be accessed for some reason, "NO PHONE" is displayed and an alert tone sounds.

- If the interconnect call you are making or the selected secure mode is not authorized, "REJECT" is displayed and an alert tone sounds.

- If your transceiver does not have the proper encryption key, "KEYFAIL" is displayed and the call must be made in the clear mode using the Clear/Secure option key or menu parameter (if encryption is selectable on the channel). Otherwise, load the proper encryption key.

4. When the telephone call is finished or if it could not be completed for some reason, end it by pressing the Phone option key or F1 (Exit) key.

6.6.3 ANSWERING A TELEPHONE CALL

1. When a telephone call is received, "ringing" similar to a standard telephone is heard and "PHONE" is displayed.

2. To answer the call, press the Phone option switch or select that menu parameter and press the PTT switch to talk and release it to listen. Since the transceiver operates half duplex, it is not possible to talk and listen at the same time.

3. When the call is finished, end it by pressing the PHONE option switch or F1 (Exit) key.

6.7 CALL ALERT

6.7.1 GENERAL

The Call Alert™ feature allows pages to be sent and received. With SMARTNET/SmartZone operation, either the Enhanced Private Conversation™ or Standard Private Conversation mode may be programmed depending on the capabilities of the radio system. With P25 Trunked operation, operation is similar to the enhanced mode.

6.7.2 ANSWERING A PAGE

1. When a page is received, five beeps sound and "PAGE" is displayed. The ID of the mobile paging you is stored as the last ID received.

2. To clear or ignore the page, press any option switch. If the PTT switch is pressed, a group call is placed on the selected channel.

3. To answer the page as a private call (see Section 6.5), press the Private Call option switch or select that menu parameter and the alias of the mobile paging you is displayed. Press the PTT switch and respond. One of the conditions that follow may also occur:

Enhanced Private Conversation Mode

- If the mobile being called is on the air, ringing is heard until the called party answers or for 20 seconds, whichever occurs first. If no answer occurs within 20 seconds, a continuous tone sounds and "NO ANS" is displayed.

- If the mobile being called is not on the air, a continuous tone is heard instead of ringing and "NO ACK" is displayed.

Standard Private Conversation Mode

- If the mobile being called is not on the air or does not answer, you will simply not hear a response.

4. When the call is finished or it could not be completed for some reason, end it by pressing the Private Call option switch or the F1 (Exit) key.

6.7.3 INITIATING A PAGE

1. With a SMARTNET/SmartZone channel selected, momentarily press the Call Alert option switch or select that menu parameter. The alias of the last ID called is displayed.

2. If required, press the Up/Down switch to display the desired mobile. The alias of each number is displayed.

3. Press the PTT switch or the F2 key and one of the following occur:

   - If five beeps sound, the system received the page and the paged mobile is on the air and received it. The page mode is automatically exited.

   - If the system received the page but the called mobile is not on the air, a single beep sounds and "NO ACK" is displayed 6 seconds after the PTT switch is pressed. Auto exit then occurs.

6.8 MESSAGING

NOTE: This feature is not available with P25 trunked operation.

The messaging feature allows preprogrammed messages to be sent to a dispatcher. Up to 16 messages can be preprogrammed, and they are identified by an alias. If a Message option switch or menu parameter is programmed, messages are sent as follows:

1. Momentarily press the Message option switch or select that menu parameter. The alias of the last message sent is displayed.

2. If required, press the Up/Down switch to display the desired message. Then send the message by pressing the F2 key or momentarily pressing the PTT switch. One of the following events then occurs:

   - If five beeps sound and "ACK RECVD" is displayed, the message was received and automatically acknowledged by the system.

   - If after five tries the message is not acknowledged, a tone sounds and "NO ACK" is displayed.

6.9 SENDING STATUS CONDITIONS

The status feature allows you to manually or automatically send your current status to your dispatcher. Up to eight status conditions can be preprogrammed, and they are identified by an alias. If the Status option switch or menu parameter is programmed, status conditions are sent as follows:

1. Momentarily press the Status option switch or select that menu parameter. The alias of the current status condition is displayed.

2. To change the current status, press the Up/Down switch until the desired status is displayed. Then to send the status, press the F2 (Select) switch or momentarily press the PTT switch. One of the following events then occurs:

   - If five beeps sound and "ACK RCVD" is displayed, the status was received and acknowledged by the system.

   - If after five tries the message is not acknowledged, a tone sounds and "NO ACK" is displayed.

6.10 EMERGENCY ALARM AND CALL

6.10.1 INTRODUCTION

Emergency Alarms and Calls are separate functions that can be individually enabled or disabled on each SMARTNET/SmartZone and P25 Trunked system. The Emergency option switch (or menu parameter) is also required for these functions. Emergency Alarms are transmitted on the last selected talk group, and Emergency Calls are transmitted on the emergency talk group programmed on the selected system (or the selected talk group if none is programmed).

The emergency hot microphone function can be programmed with emergency alarms and calls. Then when the emergency switch is pressed, the microphone audio is enabled and the transmitter keyed for the programmed hot microphone time (10-120 seconds). If "silent" emergency is programmed, no tones sound but the transmit indicator still lights. If the "Surveillance Mode" is enabled (see Section 4.7), all indicators, lights, and tones are disabled.

6.10.2 EMERGENCY ALARMS

An emergency alarm is a special data transmission on the selected talk group that alerts a dispatcher of an emergency situation (an emergency tone usually sounds at the console). Proceed as follows to activate an emergency alarm:

1. Select a SMARTNET/SmartZone or P25 Trunked channel that has this feature enabled and then press the Emergency option switch or select that menu parameter. The radio then begins automatically transmitting an emergency alarm data message and "EMERGNCY" is indicated in the display for 3 seconds.

2. When the emergency alarm is acknowledged, "ACK RCVD" is briefly displayed and the emergency acknowledge tone (two beeps) sounds. Silent operation may also be programmed in which case no tone sounds and there is no indication that an acknowledgment occurred.

3. The radio continues to transmit this message until an acknowledgment is received or the programmed number of attempts have been made. To exit this mode, power must be turned off.

6.10.3 EMERGENCY CALLS

An emergency call urgently requests access to a voice channel (an emergency tone usually does not sound at the console). To place this call, proceed as follows:

1. Select a SMARTNET/SmartZone or P25 Trunked channel that has this feature enabled and press the Emergency option switch or select that menu parameter. The emergency mode is indicated when "ACK RCVD" is briefly displayed and then "EMERGNCY" and the emergency talk group are alternately displayed.

2. To place the emergency call, manually press the PTT switch and begin speaking as with a standard call. All group calls which follow are then emergency calls (private, telephone, and call alert calls are not allowed). If the channel is changed, the call is made on the emergency talk group programmed for the new channel.

3. To exit this mode, power must be turned off.

6.11 FAILSOFT OPERATION

If a failure occurs in the SMARTNET/SmartZone or P25 Trunked system so that it cannot be used, the system directs the transceiver to automatically enter the failsoft mode. When in this mode, "FAILSOFT" and the alias of the selected channel are alternately displayed. A failsoft tone may also be heard, depending on how the repeater is programmed.

When in the failsoft mode, operation is in the conventional mode on the preprogrammed failsoft channel (a different failsoft channel can be programmed on each talk group). If a transmission is attempted before a failsoft channel is located, a continuous tones sounds until the PTT switch is released. When the radio system returns to normal operation, this is automatically detected and normal operation resumes.

6.12 SMARTNET/SMARTZONE/P25 TRUNKED SCANNING FEATURES

6.12.1 GENERAL

Scanning on a SMARTNET/Smartzone and P25 Trunked systems is called Priority Monitor Scan. The following are unique features of this type of scanning. For general scanning information applicable to all operating modes, refer to Sections 4.8 and 4.9.

- Scanning is turned on and off by the Scan option switch or menu parameter. Talk groups (channels) can be programmed so that scanning automatically starts when the talk group is selected (Autoscan).

- When responding to calls in the scan mode, the programming of the Talkback Scan parameter determines if a response always occurs on the talk group of the call (Active Group) or the Selected Group if they are different. Transmissions at other times always occur on the selected talk group.

- Each talk group can be programmed to select one of the programmed scan lists or "No List" (scanning is disabled). If scanning is enabled and the selected

channel does not permit scanning, it is automatically enabled again when a channel is selected that permits scanning.

- The selected scan list can be temporarily changed if the Scan (List) Select option switch is programmed. The procedure is described in Section 4.9.4.

- In addition to calls on channels in the scan list, pages, private/unit calls, and telephone* calls are received while scanning. Private and telephone calls are not interrupted by priority messages.

6.12.2 PRIORITY TALK GROUP SAMPLING

One talk group in the scan list can be designated a priority talk group by programming or it can be the selected talk group. When scanning, messages on a non-priority talk group are interrupted by messages on the priority talk group. Priority scanning must also be supported at the system level for it to occur as programmed in the radio.

6.13 DYNAMIC REGROUPING

The dynamic regrouping feature allows a dispatcher to change the current talk group or switch mobiles to a predefined regrouping channel to receive an important message. When the console issues a regroup order, the transceiver switches to the preprogrammed regroup talk group. If the lock mode was not specified, the selected talk group can be manually changed and the previous talk group is reselected if power is cycled. If a locked regroup command is received, the displayed talk group cannot be changed manually or by cycling power. It can be changed only after a clear order is received from the console.

Dynamic regrouping operates as follows:

1. When this command is received, alternating tones sound and the transceiver automatically changes to the regrouping channel and “DYN REGRP” is displayed.

2. Manually select the channel corresponding to that alias. If this is not done, transmission still occurs on the new channel, but the alternating tones sound each time the PTT switch is pressed.

3. Talk and listen as usual. The dispatcher cancels dynamic regrouping which is indicated by a short tone. If a standard channel is not selected after this occurs, transmission is not allowed if the talk group is assigned as a dynamic regrouping talk group only. If it is assigned as a normal talk group, normal transmissions are allowed.

6.14 SMARTZONE AND P25 TRUNKED UNIQUE FEATURES

6.14.1 INTRODUCTION

As described in Section 3.8.3, the SmartZone® mode provides wide area coverage by allowing roaming between SMARTNET and conventional sites. The P25 Trunked mode can provide access to a single trunked site or roaming between several trunked sites. Operation in these modes is the same as just described in the preceding sections (6.1-6.13) with the following additional features:

6.14.2 BUSY OVERRIDE

The busy override feature is enabled at the system level by the system manager and is not a programmable radio feature. It allows a call to be placed even if not all sites you are calling have a free traffic channel. The only sites guaranteed to be included are the Critical Sites and the sites where a Critical User is located. This feature operates as follows:

1. Assume that you have attempted to place a call and the system was busy (“BUSY” displayed and busy tone sounded).

2. Release the PTT switch and then press it for 5 seconds or more. If a chirp tone sounds with the PTT switch pressed, busy override is occurring.

   NOTE: Remember that not all members of the talk group are receiving your message. Missing members will start receiving your message as channels become available.

6.14.3 SITE TRUNKING

Site trunking occurs when a site can no longer participate in wide area trunking. When site trunking is occurring, the radio searches for other sites that may provide wide area coverage. Site trunking ends when a

***** *Telephone calling is currently not available.*

wide area coverage site is located, the current site is operating again as a wide area coverage site, an out-of-range condition occurs, or the failsoft mode is entered.

6.14.4 DETERMINING CURRENT SITE AND SEARCHING FOR NEW SITE

To display the RSSI level of the current site, press the Site Search option switch or select that menu parameter. The display then indicates the current site number as “SITE xx” and the RSSI level as “RSSI xx”. This mode is then automatically exited.

To scroll through the other programmed sites, press and hold the Site Search option switch while “SITE xx” or “RSSI xx” is displayed. If site lock is on when site search is entered (see following), the radio will be locked on the new site when this function is exited.

6.14.5 LOCKING/UNLOCKING A SITE

It is sometimes desirable to stay on a site. To prevent the transceiver from searching for a new site, lock it on the current site by pressing the Site Lock option switch or selecting that menu parameter. The display then momentarily indicates the site alias to indicate that the current site is locked (“x” is the current site number). To unlock the site, press the Site Lock switch again or the F2 (Select) key and “UNLOCK” is momentarily displayed.

SECTION 7 MISCELLANEOUS

7.1 SUPERVISORY TONES

Single Beep (Alert Tone)

- Power was turned on and a successful power-up sequence occurred (Section 3.1).
- The time-out timer is about to expire or the penalty timer has expired (Section 4.3).
- The conversation timer is about to expire (Section 5.7).
- The system received your page but the paged mobile is not on the air (Section 6.7).
- Telephone interconnect is not operational (Section 6.6).

Continuous Tone (Invalid Condition)

- A transmission is being attempted on a conventional channel programmed as receive-only.
- The transmitter is disabled by the busy channel lockout feature (Section 5.4).
- The transmitter has been disabled by the time-out timer feature (Section 4.3).
- The transmitter has been disabled by the conversation timer (Section 5.7).
- An out-of-range condition exists (SMARTNET/SmartZone and P25 trunking only).
- A transmission is being attempted before the penalty timer has expired (Section 5.6).
- Dynamic regrouping has been exited but the dynamic regrouping channel is still selected (Section 6.13).

Single Short Medium-Pitch Tone

- A valid key has been pressed.

Single Short Low-Pitch Tone

- An invalid key has been pressed.

Medium Tone (No Acknowledge)

- The paged mobile did not acknowledge the page (Section 6.7).
- The message that was sent has not been acknowledged (Section 6.8).
- The status condition that was sent has not been acknowledged (Section 6.9).

Five Beeps (Recurring)

- The page was received (Section 6.7).

Two Short Tones

- A private call was received (Section 6.5).

Five Beeps

- The paged mobile received the page and acknowledged it (Section 6.7).
- The message that was sent has been received and acknowledged (Section 6.8).
- The status condition that was sent has been received and acknowledged (Section 6.9).

Four Beeps

- The emergency alarm condition was acknowledged (Section 6.10).

- Four low tone beeps indicate call back mode (the system is no longer busy)

Alternating Tone

- Dynamic regrouping has occurred (Section 6.13).
- Dynamic regrouping has occurred but the regrouping channel is not selected (Section 6.13).

Busy Signal

- The radio system is busy or a busy condition exists when making a telephone call.

Three Medium Pitch Tones

- A channel is available after a busy condition occurred (SMARTNET/SmartZone only).

7.2 SYSTEM OPERATOR PROGRAMMING

As noted several times in this manual, programming determines the availability and specific operation of many features. This usually refers to the programming performed by the PCConfigure programmer when the radio was set up, not to any programming a user can perform. If a feature is controlled by a front panel option switch and that switch is not available, it is probably not available.

If the Keypad Programming option switch is available, you can reprogram some conventional channel parameters. Refer to Section 5.17 for more information.

7.3 SPEAKING INTO MICROPHONE

For best results, hold the transceiver about 1-2 inches from your mouth and speak at a normal conversational level. Do not shout since it distorts your voice and does not increase range. Make sure that the PTT (push-to-talk) switch is pressed before you begin to speak and released as soon as the message is complete.

7.4 OPERATION AT EXTENDED RANGE

When approaching the limits of radio range, the other party may not be able to hear your transmissions and there may be an increase in background noise when messages are received. You may still be out of range even though you can hear a message. The reason for this is that the signal you are receiving is usually transmitted at a higher power level than the one transmitted by your transceiver. Communication may be improved by moving to higher ground or away from shielding objects such as tall buildings or hills.

7.5 LICENSING

A government license is usually required to operate this transceiver on the air.

7.6 TRANSCEIVER SERVICE

If the transceiver is not responding to any key presses, the keypad may be locked. Refer to Section 3.6 for more information.

If “PASSWORD” is briefly displayed when power is turned on and you are prompted to enter a password, the Power-Up Password feature is enabled. Refer to Section 3.2 for more information.

If “UNPROGRAMD” is displayed, the cause could be any of the following:

- An unprogrammed channel is selected. Select a programmed channel.

- The selected channel is programmed for an option that is not installed or an error in programming was detected. Reprogram the radio.

If no characters appear in the display, the battery may be discharged or defective. Try another battery. If some other problem is occurring, turn power off and then on again to reset the control logic. Also make sure that the controls are properly set. If it still does not operate correctly, return it for service.

NOTE: There are no user-serviceable components in the transceiver. Altering internal adjustments can cause illegal emissions, void the warranty, and result in improper operation that can seriously damage the transceiver.

SECTION 8 SECURE COMMUNICATION (ENCRYPTION)

8.1 GENERAL

8.1.1 INTRODUCTION

This transceiver may be equipped to provide secure communication on some or all channels. This feature encrypts the voice so that it can be understood only by someone using a transceiver equipped with a similar encryption device and encryption codes.

When a secure call is received or transmitted,  is indicated in the display. If equipped with the Clear/Secure option switch and the current channel is programmed to allow switch selection, secure communication can be manually enabled and disabled by that switch. Otherwise, channels are strapped to Clear or Coded operation. Secure communication can be programmed on a per channel basis to operate in various ways. More information follows.

8.1.2 ENCRYPTION ALGORITHMS

SecureNet™

SecureNet encryption is a proprietary Motorola protocol that digitizes the voice and then encrypts it using the DES or DVP algorithm. The SecureNet protocols include the following:

- DVP (Digital Voice Privacy) is an earlier encryption method that is self synchronizing using cipher feedback. It was originally designed to be used by anyone needing protection from unauthorized eavesdropping.

- DES (Data Encryption Standard) provides a higher level of security, and also uses cipher feedback. It was originally designed to be used only by the Federal government.

- DVP-XL/DES-XL - A disadvantage of the DVP and DES encryption types is reduced communication range when compared to clear voice. The DES-XL and DVP-XL methods were designed to provide better range but at the cost of lower voice quality. They use a different type of feedback called counter addressing. These types of encryption are not available with 5100 models.

- DES-OFB - A form of DES encryption for digital channels that uses output feedback. This protocol does not result in the degraded range that occurs with analog channels.

AES (Advanced Encryption Standard)

A new encryption standard called AES is replacing DES-OFB encryption on digital (P25) channels. It uses a 128, 192, or 256 bit encryption key instead of the 56-bit key used with DES. EFJohnson radios support only 256-bit AES keys. The type of encryption (DES or AES) is determined by the encryption key that is selected (see Section 8.1.5). It is not specified by radio programming.

8.1.3 ENCRYPTION AVAILABLE WITH VARIOUS CHANNEL TYPES

Conventional (Non-Trunked) Channels

On analog conventional analog channels, the protocol that is used to provide secure communication is SecureNet™ DES encryption (DES-XL is currently available with 53xx mobiles but not 51xx portables).

On digital (Project 25) conventional channels, the DES-OFB or AES protocol is used (AES is available with Flash code 1.8.0 or later). In the receive mode, clear and secure messages are always automatically detected.

SMARTNET/SmartZone and P25 Trunked Channels

On analog SMARTNET channels, only SecureNet DES protocol can be selected. On analog SmartZone analog channels, DES encryption can be selected only with Flash code Version 1.7.0 or later. With 53xx mobiles, SMARTNET/SmartZone analog encryption is not currently available. On digital SMARTNET/SmartZone and P25 Trunked channels, DES-OFB or AES protocol is available (AES is available with Flash code 1.8.0 or later). Talk groups can be strapped to Clear, Coded, or Switch selectable (see

Section 8.1.6), and clear and secure messages are always autodetected.

The following calls require their own encryption key selection: emergency, failsoft, patch, telephone, private, and system-wide.

8.1.4 FIPS AND NON-FIPS MODES

FIPS 140-2 is a Federal Information Processing Standard that was recently approved by the United States Secretary of Commerce. This standard specifies Federal security requirements for cryptographic modules for a wide range of applications and environments.

The 5100 series portable radios are currently not FIPS certified but this feature is planned for a future release of this radio. The 51xx FIPS and Non-FIPS certified modes will be as follows:

FIPS Certified - DES-OFB and AES encryption on digital (P25) channels

Non-FIPS Certified - All types of encryption on analog channels.

There will be no specific indication that FIPS certified encryption is selected unless it is indicated by the channel alias that is displayed when the channel is selected. This alias is determined by programming. As described in Section 8.1.1,  is indicated in the display when any type of encryption is selected.

8.1.5 ENCRYPTION KEYS

NOTE: The transceiver must be connected to a constant power source to preserve the encryption keys in memory. Storage capacitors maintain the supply voltage (and these keys) for approximately 30 seconds to allow the battery to be changed. Therefore, when changing the battery of a transceiver containing keys, make sure to reattach another battery within 30 seconds.

General

NOTE: The term "SLN" is from the Project 25 specification and is equivalent to "CKR" (Common Key Reference) also used to define this parameter.

Each channel which uses SecureNet or AES encryption is programmed with a hardware location of 0-15 of the encryption key used by that channel. In addition, if OTAR (Over-The-Air-Rekeying) is used, an SLN (Storage Location Number) is programmed which links each hardware location to a key slot of a keyset. Keys are directly loaded into the radio by a keyloader or by OTAR controlled by a key management facility (KMF). Refer to Section 8 for more OTAR information.

Encryption Key Select

NOTE: This feature is available on conventional channels only.

When multiple encryption keys are programmed (see preceding information), the Key Select option switch can be programmed to allow selection of another key for the current channel. This feature changes the hardware location of the key, and the change is permanent (cycling power or selecting a different channel does not reselect the original key). Therefore, to switch back to the original key, it must be manually reselected. Proceed as follows to select a key:

1. Press the Key Select switch or select that menu parameter and HWKEY x is displayed. The "x" indicates the current key selection from 0-15.

2. Press the Up/Down switch to display the desired key and then press the F2 (Select) key to select it. Press the F1 (Exit) or Key Select switch again to return the display to normal operation.

Encryption Key Erase

A Key Erase menu item can be programmed that allows the user to permanently erase all stored keys. If OTAR TEK and KEK keys are stored, all keys of both types are erased. This function can be used to ensure that unauthorized encrypted calls can no longer be placed or received by a radio.

8.1.6 CLEAR/SECURE STRAPPING

Transmissions on an analog channel are in the clear mode if the channel has been strapped to the clear mode by programming, and in the SecureNet

** This feature requires 51xx operating (Flash) software 1.9.0 or later and PCConfigure 1.20 or later.*

mode if it has been strapped to SecureNet. If the channel has been strapped to “switched”, the mode is selected by the Clear/Secure option switch. When a message is received or transmitted in the secure mode,  is displayed.

If the channel has been strapped “Clear” and the option switch selects the “Secure” mode on power up and a transmission is attempted, “Clear Only” is displayed and transmitting is disabled. Conversely, if the channel is strapped “Secure” and the option switch selects the “Clear” mode on power up and a transmission is attempted, “Secure Only” is displayed and the transmitter is disabled. The radio can be programmed* to ignore the switch setting when “Clear” or “Secure” are programmed so that these indications do not occur.

If an attempt is made to transmit a secure message without loading the corresponding key, “KEYFAIL” is displayed. The message must then be transmitted in the clear mode (this is possible only if the channel is strapped to “switchable”) or the key must be loaded.

8.1.7 460 SCRAMBLING

The 460 Scrambling protocol is a proprietary Transcrypt protocol that is compatible with the stand-alone scrambling option from Transcrypt. The 460 type of scrambling is not available with 51xx transceivers.

8.1.8 TRANSMIT MODE OPTIONS

The following transmit options are available when SecureNet encryption is selected:

Clear - All calls are in the clear mode unless responding to a secure call. If the response is then made within the delay time (see Section 4.8), it occurs in the secure mode.

Coded - All calls are made in the selected secure mode.

Switched - The mode is selected by the Clear/Secure switch. When the clear mode is selected by this switch, “CLEAR” is flashed, and when the secure mode is selected, “SECURE” is flashed.

8.1.9 RECEIVE MODE OPTIONS

The following receive options can be programmed with conventional operation. With SMARTNET/SmartZone and P25 Trunked operation, encrypted calls are received if the proper key is programmed.

No Autodetect - Only signals coded like the transmit signals are received.

Secure Autodetect - Both clear and SecureNet signals are automatically detected. This mode is automatically selected if the transmit mode is switch selectable.

Proper Key Autodetect

Analog Channels

When this feature is disabled and a message is received with the wrong SecureNet key, the audio unmutes and garbled (encrypted) audio is heard. However, if this occurs with this feature enabled, the audio remains muted.

Digital Channels

When this feature is enabled and a message is received with a different key, but the key resides in the radio, the audio is decrypted and received normally even though the key is assigned to a different talk group. If this feature is disabled or the key does not reside in the radio, the audio remains muted.

8.2 OTAR (OVER-THE-AIR REKEYING)

8.2.1 INTRODUCTION

What Is OTAR?

OTAR stands for “Over-The Air-Rekeying”. This is the process of sending encryption keys and related key management messages over-the-air to specific radios. The advantage of OTAR is that it allows these keys to be quickly and conveniently updated when necessary. It is no longer necessary to periodically travel to the radio location or bring the radio into a maintenance facility to load new keys.

The actual OTAR rekeying functions are performed by a Key Management Facility (KMF) that sends Key Management Messages (KMM) to the radios. These messages are themselves encrypted using a unique key. Radios must be OTAR-compatible and programmed for OTAR for this type of rekeying to occur.

Currently, OTAR is available only on P25 conventional channels, and only to program DES-OFB keys. It is not used on SMARTNET/SmartZone or P25 trunked channels or to load DES/DES-XL or the new AES keys. This is true industry-wide and not just with EFJohnson equipment.

What Are Encryption Keys?

An encryption key is a cryptographic variable that is required by the encryption algorithm to encrypt and decrypt voice or data. To maintain system security, these keys must be protected from disclosure and also periodically replaced or updated.

With the DES encryption used by EFJohnson radios (see Section 8.2.3), the same encryption key is used by both the encrypting (sending) and decrypting (receiving) radio. DES encryption keys are generated from a string of 16 hexadecimal characters. Another four hexadecimal characters are used to specify the key ID.

Multiple keys can be loaded into a radio using OTAR or manual loading. The process by which encryption keys are generated, stored, protected, and changed is referred to as Key Management.

The channels, talk groups, and other calls that use encryption are linked to a specific Physical ID (PID) when the radio is programmed using the PCConfigure programming software. For example, Zone 1, Channel 3 could be programmed to select the key in location 12. With OTAR, an additional Storage Location Number (SLN) provides the link from the PID to a key slot of the keyset which contains the key (see Section 8.2.6).

When an encrypted message is transmitted, the encryption Algorithm ID (ALID) and key ID (KID) are usually included in the message. This tells the receiving radio which key and algorithm must be used to decrypt the message.

8.2.2 DEFINITIONS

Algorithm - Refers to the specific encryption standard that is used to encrypt a message. Each standard uses different calculations to perform the encryption.

Algorithm ID (ALGID) - Identifies the algorithm used to encrypt a message. This ID and the key ID are usually transmitted with an encrypted message.

Black - Refers to information that is encrypted. The opposite is “Red” which refers to unencrypted information.

Common Key Encryption Key (CKEK) - A KEK common to a group of subscriber units which share the same encryption keys (are part of same crypto group). The use of a common key allows the subscriber units to be rekeyed by the KMF using one Key Management Message. Refer to “KEK” for more information.

Common Key Reference (CKR) Group - This refers to a group of subscriber units which share the same encryption keys. These common keys are required for them to talk to each other. For example, the officers of a police department that talk to each other may have one or more keys in common that would be referred to as a CKR group. CKR groups are used to aid KMF key management. A subscriber unit may contain keys for more than one CKR.

Crypto Group - A group of up to 16 keysets containing the same type of keys (either TEK or KEK). Only one keyset in a crypto group is active at a time.

Cryptographic Variable - The variable used by a cryptographic algorithm to encrypt a message. Also called a “key”.

Cryptonet - See Common Key Reference (CKR).

Currency - Relates to the need for key updates. If a subscriber unit is current, it does not require a key update at the current time. If it is not current, the KMF has new keys for that subscriber unit or CKR group

have not been sent or have been sent but not acknowledged.

Group Rekeying - The process of changing the keys in several subscriber units with a single message addressed to the group rather than changing each subscriber unit separately. This reduces system overhead and makes rekeying more efficient. Subscriber units in the same group must be programmed with a common KEK. See also Key Management Group.

Key - A variable used by a cryptographic algorithm to encrypt voice or data.

Key Encryption Key (KEK) - A key used to encrypt keys contained in Key Management Messages (KMMs) during OTAR. These messages may themselves be encrypted by the currently active TEK. There are KEKs unique to a subscriber unit (UKEK) and common to a group (CKEK). The other type of key is the Traffic Encryption Key (TEK) used to encrypt voice and data messages.

Key ID - This is a 16-bit (four hex digit) number identifier for an encryption key which allows the key to be identified without revealing the actual key variable. This ID and the Algorithm ID uniquely identify a key within the KMF or subscriber unit. The Key ID and Algorithm ID are usually transmitted with a message to identify the key and algorithm that must be used to decrypt a message. Key ID 00000 is not used with OTAR.

Key Management Facility (KMF) - The equipment and software which provide OTAR and related key management services to the subscriber units.

Key Management Group (KMG) - Two or more subscriber units with the same group RSI (Radio Set Identifier) which have one or more keysets in common. They are managed as a single subscriber by the KMF.

Key Management Message (KMM) - These are the messages composed by the KMF to send encryption information to subscriber units via the KVL or OTAR. KMMs are themselves encrypted using two layers of encryption: inner and outer. The inner layer of encryption is the KEK and the outer layer is the TEK. At this layer, the KMMs are also included in a Common Air Interface (CAI) message which adds another layer of addressing. In addition, a Message Authentication Code (MAC) is used.

Keyset - A group of keys of the same type (KEK or TEK) that are managed as a single entity (they can be updated, deleted, and rekeyed with a single command).

Keyset Changeover - The process used by the KMF to switch a subscriber unit to another keyset so that the unused keyset can be replaced without interrupting encrypted communication.

Key Variable Loader (KVL) - This is a handheld device which is connected directly to a subscriber unit in order to load encryption keys. All keys stored in the KVL are themselves encrypted. The KVL is used to perform the initial key loading of a subscriber unit so that it contains the basic keys needed for OTAR by the KMF.

Logical Link ID (LLID) - An ID transmitted with a data message to identify the destination of the message.

Over-The-Air-Rekeying (OTAR) - The process of sending new encryption keys over the air using an RF interface.

Red - Refers to information that is not encrypted. The opposite is “Black”.

Rekey - The process of preparing, sending, and loading encryption keys into a subscriber unit for current or future use. This may be done over-the-air (OTAR) or by directly connecting a keyloader to the subscriber unit.

Radio Set Identifier (RSI) - Subscriber units are programmed with one or more Radio Set Identifier (RSI) numbers that identify the unit for OTAR purposes. The RSI can be unique to a individual subscriber unit or unique to a group of subscriber units. An individual RSI is always assigned and one or more group RSIs may be assigned. The individual RSI is typically programmed when the subscriber unit is initially brought into service. The KMF is also identified by an RSI (KMFRSI) to use as the destination of any KMMs a subscriber unit originates. The KMMs

(Key Management Messages) generated by the KMF (Key Management Facility) are addressed to a specific RSI.

Storage Location Number (SLN) - The link to a specific key (TEK or KEK) in the active keyset. The SLN specifies both a crypto group and a key within the keysets in the crypto group.

Traffic Encryption Key (TEK) - A key used to encrypt voice or data. The other type of key is the Key Encryption Key (KEK) which is used to encrypt keys contained in Key Management Messages.

Unique Key Encryption Key (UKEK) - A KEK unique to a particular subscriber unit. Refer to "KEK" for more information.

Zeroize - The process of deleting all keys from a compromised subscriber unit to disable it. To make the unit functional again, the keys must be reloaded by the KVL.

8.2.3 ENCRYPTION ALGORITHMS

Data Encryption Standard (DES) - This is a symmetric key algorithm in which the same key is used to encrypt and decrypt a message. The key must be known to only the sender and recipient of a message in order for protected communication to occur. DES/DES-XL encryption is used on analog channels, and DES-OFB encryption is used on digital channels.

Advanced Encryption Standard (AES) - This is a new, more secure encryption standard that is replacing DES on digital (P25) channels. It uses an encryption key of 128, 192, or 256 bits instead of the 56-bit key used with DES. EFJohnson radios support only 256-bit AES keys. Currently, OTAR does not support AES rekeying, so these keys must be loaded manually by a key loader such as the KVL.

The type of encryption (DES or AES) is determined by the key that is selected and not by PCConfigure programming. AES encryption is an optional radio feature that must be purchased and then enabled at the factory.

Public Key (PK) - This is an asymmetric key algorithm in which a different key is used to encrypt and decrypt a message. The encrypt key is usually public knowledge and only the decrypt key is secret.

8.2.4 ENCRYPTION KEY TYPES

There are two different types of keys used with encryption:

TEK (Traffic Encryption Key) - The key used to encrypt voice and data traffic. All radios using encryption must have at least one of these keys.

KEK (Key Encryption Key) - The key used to encrypt keys contained in OTAR Key Management Messages (KMMs). All radios which use OTAR must contain at least one of these keys. The KEK used to decrypt/encrypt keys in an OTAR message is defined by the algorithm and key IDs transmitted in the decryption instructions field. A KEK may be unique to a particular radio (UKEK) or common to a group of radios (CKEK).

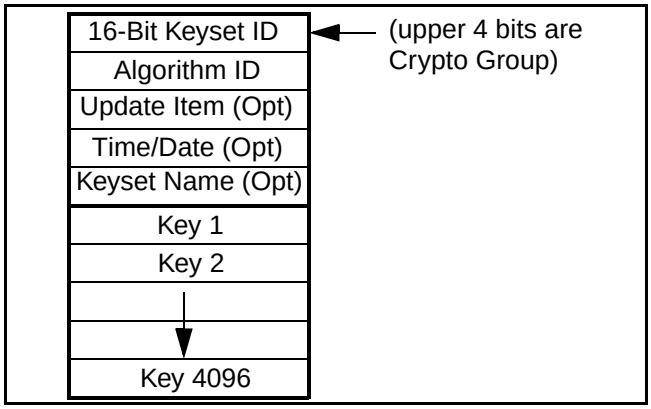

Figure 8-1 Keyset Diagram

8.2.5 KEYSETS AND CRYPTO GROUPS

Keysets

To simplify key management, a number of keys may be grouped together in a keyset. A keyset is simply a set of one or more keys of the same type (either TEK or KEK). Keysets are identified by Keyset IDs, and the upper four bits of this ID specify the crypto group (see next section). With EFJohnson radios, each keyset can contain up to 128 keys. Refer to Section 8.2.10 for more keyset information.

The active keyset is usually selected by the Key Management Facility. Automatic keyset changeovers

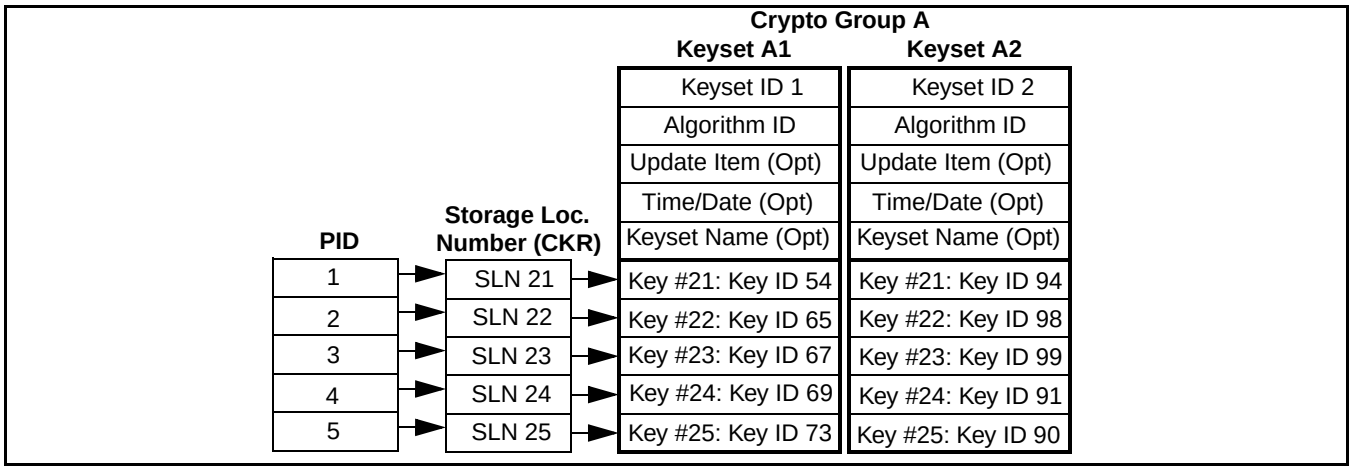

Figure 8-2 Key Selection Example

or updates are not supported by EFJohnson radios. Keysets are assigned a logical ID, and keyset names are also supported. A diagram of a keyset is shown in Figure 8-1. Some information may be optional as shown. The 51xx portable does not support or use the Update Item and Time/Date parameters.

Crypto Groups

A crypto group contains up to 16 keysets of the same type of key, either TEK or KEK (see Section 8.2.4). However, only two keysets are typically used. Only one keyset within a crypto group is active at a time, and the others may be activated later. Crypto groups are used to help manage keys such as when a radio uses keys with different active times or multiple algorithms. The upper four bits of the keyset ID are the crypto group ID.

8.2.6 KEY SELECTION

Linking to a Storage Location Number (SLN)

Each channel (conventional) or talk group (trunked) that utilizes encrypted communication is programmed with a Physical ID (PID) that specifies the encryption key to be used. When SLN/CKR key management is used, a link table is also programmed that links each PID to a Storage Location Number (SLN) that points to a specific encryption key slot in the active keyset.

The use of this type of indirect linking allows keysets and key IDs to be changed via OTAR while keeping the mapping from the channel or talk group the same. For example, as shown in Figure 8-2, PID selects SLN 24 which selects key slot 24 in both keysets. This slot contains Key ID 69 in Keyset 1 and Key ID 91 in Keyset 2. Only one keyset is active at a time.

The radio may also be programmed with a Key Select option switch that allows the user to change the PID of a channel or talk group. It may also have a Change Keyset option switch that allows the user to select the active keyset. With data transmissions, the key may be linked by the Logical Link ID (LLID) contained in the data message or the channel on which the transmission is made.

Key and Algorithm IDs

Each encryption key is programmed with a Key ID (also called Logical ID). This ID plus the algorithm ID (ALGID) is transmitted in the message. The radio receiving the message must have a key programmed with the same Key ID in order to decrypt it. Keys may or may not be autodetected, depending on radio programming.

8.2.7 KEY MANAGEMENT FACILITY

The Key Management Facility (KMF) provides key management and OTAR functions to applicable radios within the radio system. One of the main tasks of the KMF is to maintain a data base of information contained in each radio. This information may include the following:

- TEKs (main Traffic Encryption Keys)
- KEKs (Key Encryption Keys) used to encrypt OTAR messages
- Keysets (groups of TEKs or KEKs)
- Crypto groups (groups of keysets)
- Cryptonets (groups of radios using same keys)
- Individual and group Radio Set Identifiers (RSIs)
- List of probable lost or stolen radios

The KMF performs OTAR functions by exchanging Key Management Messages (KMMs) with the radios. Both the KMF and radio can originate messages. Some functions performed by the KMF are as follows:

- Loading new keys
- Modifying keys
- Initiating keyset switch overs
- Modifying keyset attributes
- Deleting one or more keys to remove a radio from a cryptonet)
- Deleting all keys (zeroize) when a radio may be lost or compromised
- Determining if a radio is on the air and reading key information
- Changing individual and group RSIs

8.2.8 RADIO REQUIREMENTS

Currently, EFJohnson 51xx portables and 53xx mobiles that meet the following requirements support OTAR:

Software Version Number - The 51xx must have software version number 1.5.0 or higher, and the 53xx must have ARM code 1.16.0 or higher and DSP code 1.32.0 or higher. The software version number is briefly displayed when power is turned on. It can also be determined using the PCConfigure programming software by selecting the Transfer > Read Version Info from Radio menu parameter.

Programming - An RSI and UKEK must be programmed (see next section).

Options Enabled - The data, DES encryption, and OTAR options must have been enabled at the factory. To determine what options are enabled, using the PCConfigure programming software, select the Transfer > Read Options From Radio menu parameter.

8.2.9 PROGRAMMING REQUIREMENTS

NOTE: Refer to Section for information on 53xx programming.

Programming By PCConfigure

The following OTAR parameters must be programmed using the PCConfigure programmer (Version 1.17 or later is required).

1. On the global screen, select the SLN (CKR) Key Management mode.

2. On the Global screen, click the 

button and associate the PIDs (hardware key locations 0-15) with SLNs.

3. On the Global screen, select “Erase Keys on Keyset Change” if the keys in the original keyset are erased when OTAR or the Keyset option switch is used to select the other keyset. If not selected, the keys in the original keyset are not erased when this occurs.

4. With the 53xx only, on the Global screen select “Infinite Key Retention” if keys are to be retained until the storage capacitance discharges when the radio is disconnected from power. If keys are to be erased immediately when power is removed, do not select this parameter.

5. On the Radio Wide Conventional screen, select the Digital Unit and Unit RSI IDs. The RSI ID can be set to the Digital Unit ID only, but later can be changed by the KMF if desired. Note these two numbers.

6. On the Per System Conventional screen, select OTAR Enabled = On and Data Registration = On.

Data System Registration

The 51xx portable does not support dynamic data registration. Therefore, each radio must be manually registered on the RNC Console by entering the following command:

LCRD 03 06 00 1234 7F xx xx xx 0A 0A 00 07 00 yy

“xx xx xx” is the hex value of the Digital Unit ID entered in PCConfigure. Refer to the console docu-

mentation for the value of “yy” or use “00”. This registration needs to be done only once.

Programming By KVL Keyloader

Program the following using the KVL 3000 Keyloader:

1. Select the ASTRO-25 and KMF modes.

2. Create a new key with CRK 61440 and Key ID F5A0. UKEKs are always stored in SLN 61440 using Key ID F5A0 as far as the KMF is concerned.

3. Enter the 8-byte UKEK (overwrite = yes if requested) and load CKR 61440 into the radio.

4. Load the proper target RSI into the radio using the KVL. This should be decimally equivalent to XX XX XX in Section . This step should not be needed if it is the first time the radio is being set up for OTAR or if the radio dumps keys due to long-term battery disconnect, since it is reassigned from the Unit RSI. However, it is needed if the unit is manually deleted from the KMF and then recreated since the message number must be reset to 0 (the KVL Load Target RSI command reset the message number to 0).

5. Load the proper KMFRSI into the radio using the KVL. This step is usually not needed since this number defaults to 9999999.

6. Load the proper message period into the radio using the KVL (typically 1000).

7. Verify that the above information was properly stored in the radio by viewing it using the KVL.

NOTE: It is not necessary to have a TEK programmed before OTAR can be performed. If the KMF determines that a radio does not contain a TEK, it initiates a warm start-up sequence in which a temporary TEK is transferred to the radio.

8.2.10 RADIO OTAR CAPABILITIES

53xx Mobile Capabilities

The 53xx mobile transceiver uses the Motorola UCM encryption module (NTN1712A) or an AES-capable module such as NNTN4355. Therefore, the OTAR capabilities are determined by that module. All capabilities of the Motorola KVL and KMF are supported. Initial radio programming by the PCConfigure software is the same as described in Section 8.2.9.

51xx Portable Capabilities

Keysets

- Up to three keysets and it is assumed all three are always present.
- Keysets 1 and 2 are for TEKs. Only one is active at a time.
- Keyset 255 is for KEKs and is considered active all the time
- Each keyset can have up to 128 keys
- AES encryption is supported (with Flash code 1.8.0 or later) but keys currently cannot be loaded by OTAR

RSI (Radio Set Identifier)

- One individual RSI
- One group RSI

OTAR Messages That Are Supported

The following KMM Message IDs are recognized by or sent from the 51xx portable:

CHANGE RSI	0x03
CHANGE RSI RESPONSE	0x04
KEYSET CHANGEOVER	0x05
KEYSET CHANGEOVER RESPONSE	0x06
DELAYED ACK	0x07
HELLO	0x0C
INVENTORY	0x0D
INVENTORY RESPONSE	0x0E
MODIFY KEY	0x13
MODIFY KEYSET ATTRIBUTES	0x14
MODIFY KEYSET ATTRIBUTES RESPONSE	0x15
NEGATIVE ACK	0x16
NO SERVICE	0x17
REKEY ACK	0x1D
REKEY	0x1E
WARM START	0x20
ZEROIZE	0x21
ZEROIZE RESPONSE	0x22

OTAR Option Switches

The following additional option switches can be programmed with the 51xx portable and 53xx mobile to control OTAR functions:

OTAR Rekey Request - Sends a message which tells the KMF that the radio is on the air and requests rekeying. The following status messages are displayed which indicate the progress of this function.

Rekeying - A radio-initiated rekeying session is in process.

No Ack - No response was received from the KMF in response to an Identify request before time out occurred (approximately 30 seconds).

Ack Rcvd - An acknowledgement was received in response to an Identify request.

No Service - A “No Service” reply was received from the KMF. No rekeying will take place.

Rekey Fail - Either the rekey command failed or timed out (after approximately 30 seconds). This message could indicate that the rekey request message was not received by the KMF. However, depending on the KMF configuration and channel traffic, it is possible that the message was received and a response is still pending.

Rekeyed! - The rekey session initiated by the radio was successful.

Change Keyset - Toggles the active keyset between Keyset 1 and Keyset 2. The new active keyset is briefly displayed and then normal operation resumes.

Erase Keys - Erases all TEK and KEK keys contained in the radio.

OTAR Menu Parameters (51xx Only)

The following OTAR menu parameters can be programmed with the 51xx portable:

OTAR Rekey - Selecting this menu parameter displays a submenu which allows the selection of the following parameters. To select one of these parameters, highlight it and press F2.

Rekey - Performs the same function as the OTAR Rekey Request option switch described in the preceding section.

Need KEK - Sends a request for a new KEK (Key Encryption Key). Upon receiving this message, the KMF marks the radio as requiring service. One time this function may be selected is if the radio dumps it keys.

Identify - Sends a message which tells the KMF that the radio is on the air. Currently, the KMF always responds with “No Service”, even if the keys are not up to date. If “No Ack” is displayed, the KMF may not have received the message (see preceding section). This function can be used to test communication without initiating the rekeying that occurs with the preceding “Rekey” function.

Erase Keys - Erases all keys in the radio the same as the Erase Keys option switch described in the preceding section.

Chg Keyset - Toggles the active keyset between Keyset 1 and Keyset 2 the same as the OTAR Keyset Select option switch described above. The current active keyset is indicated by an asterisk. To change to the other keyset, highlight it and press the F2 key.

SECTION 9 DETERMINING AVAILABLE OPTIONS

9.1 GENERAL

This manual describes the operation of all features that are currently available for the 51xx transceiver. However, many of these features are optional and therefore may not be available in your radio. For example, Project 25 trunked operation is optional and may not be available.

Availability of optional features is controlled by factory programming of the control logic. Only those features that are specifically ordered and enabled in a particular radio are available for use and can be programmed. The features controlled by factory programming are as follows:

- Project 25 conventional operation
- Project 25 trunked operation
- STAR roaming with P25 trunked operation *[1]*
- SMARTNET operation (analog voice)
- SmartZone operation (analog voice)
- Digital SMARTNET/SmartZone voice
- DES voice encryption
- AES voice encryption *[2]*
- OTAR (Over-The-Air Rekeying) of encryption keys
- Keypad programming (Fed Gov't users only)
- 512 channels/talk groups
- Zonefail site lock

[1] 5100 radios with Flash code 1.8.0 or later require that this option be factory enabled to roam across zone controller boundaries. With previous code versions, this option was always enabled by default.

[2] AES encryption is available only with Flash code 1.8.0 or later. This status of this option is not currently displayed by PCConfigure.

Currently, the only operating mode that is standard with all models is the conventional analog mode. Other variables such as frequency range are hardware dependent instead of software dependent.

9.2 UPGRADING A RADIO WITH NEW OPTIONS

The capability exists to upgrade radios in the field with new features. A new feature can be purchased and a special encrypted code string keyed to the ESN (Electronic Serial Number) of the radio is then provided by the EFJohnson Company. This string is in the form of a computer file, and is downloaded to the radio using the PCConfigure programming software. This is initiated by clicking the "Update Options" button on the Radio Options screen shown in Figure 9-1.

9.3 USING PCCONFIGURE TO DETERMINE OPTIONS

To determine what software options have been enabled in a particular radio, it is recommended that you use the PCConfigure™ programming software to read and display what options are installed. Proceed as follows:

1. Connect the computer to the radio and start the program as described in the documentation included with the PCConfigure software.

2. Select the 51xx radio type by selecting menu parameter ***Radio > Series > 5100 Portable***.

3. To display the Radio Options screen shown in Figure 9-1, select ***Transfer > Read Options From Radio***.

4. The check boxes indicate which options are enabled in the radio. They are for informational purposes only and cannot be edited.

EXAMPLES

The following are examples of items that need to be checked to program various optional features:

P25 Conventional Operation with DES Encryption and OTAR

P25 Options - Conv. Mobile Data, Digital Conv
Encryption Options - P25 DES OFB
OTAR Options - Conventional

P25 Trunked Operation with DES Encryption

P25 Options - Digital Conventional
Encryption Options - P25 DES OFB
Trunking Options - P25 Trunking

SMARTNET Analog and Digital Operation with Encryption

P25 Options - Digital SMARTNET/SmartZone
Encryption Options - DES and/or DES-OFB
Trunking Options - SMARTNET Trunking

NOTE: The "Feature Disable Options" are currently not used, so those features are always available

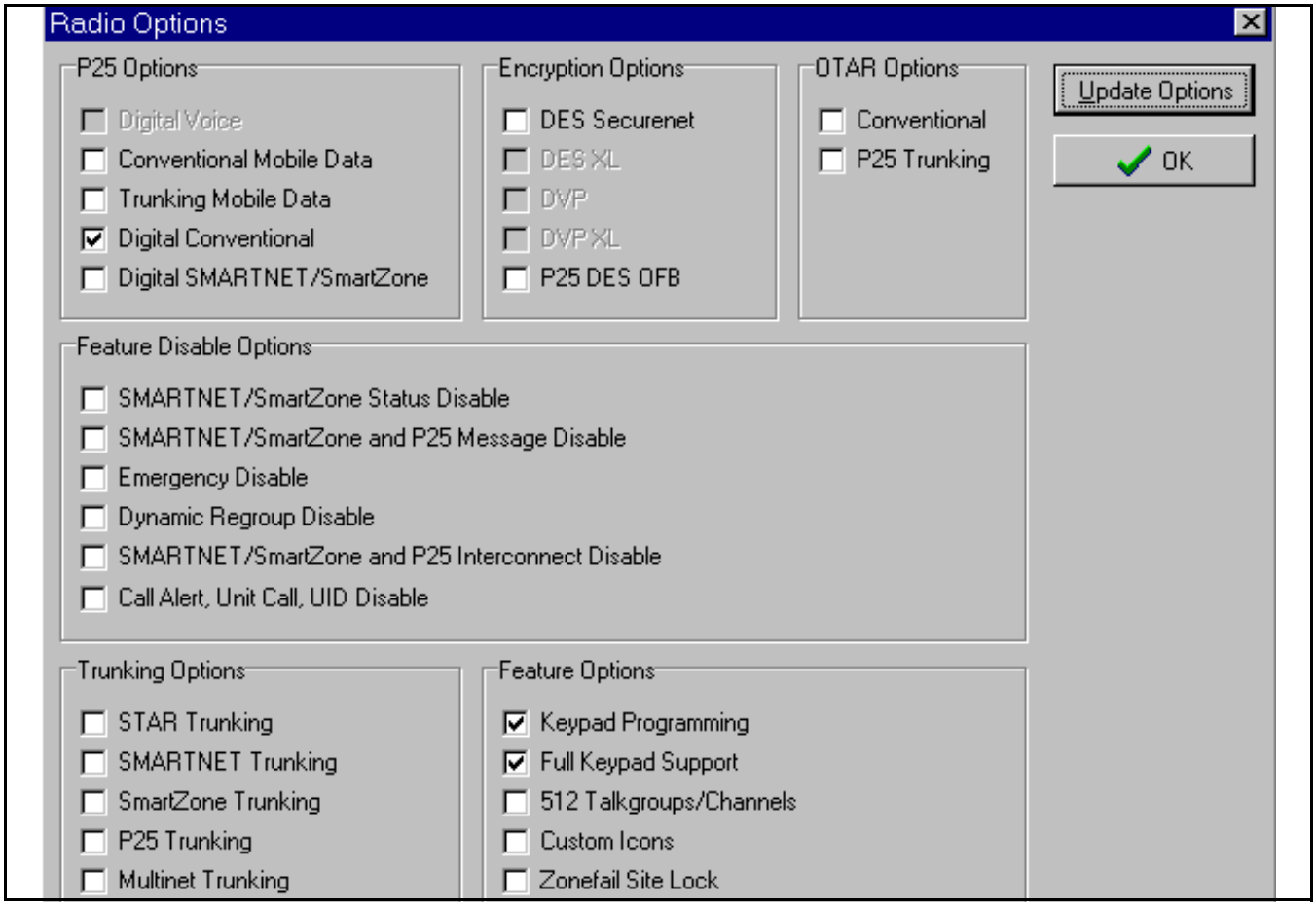

Figure 9-1 PCConfigure Radio Options Screen (5100)

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